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CONTENTS.

Rural Development.

IN 1933 the Government of Bombay published an interesting brochure on Village Improvement, which contains a draft scheme for the betterment of the villager and the village,—drawn up by Sir Frederick Sykes. Recently the Government of India have sanctioned large grants to be utilised by provincial governments for rural uplift and last month Mr. R. S. Sathianathan's report on indebtedness in rural areas of Madras was published. At October session of the Representative Assembly of Mysore, Sir Mirza M. Ismail reviewed the progress of work in the advancement of the moral and material well-being of villages under the jurisdiction of his administration. Leaders of public opinion exhort the unemployed young graduates to go to the village and earn a living by serving its population. There are several semi-official and private agencies devoting their time and energies in the work of elevating the rural people. Bright days are ahead for the Indian villages. The universal manifestation of tender solicitude for the amelioration of the conditions of rural life is a phenomenon for which history furnishes few parallels. The general desire to serve the interests of the rural population is a recognition of the fact that this backwardness must retard the progress of the body politic and their insanitary surroundings must all at times be a source of danger to the public health of the village and of the urban areas. It is obvious that the indigence and indebtedness of rural population must react on the general revenues of Government and on the prosperity of industries. The isolation of large sections of population from the centres of administrative activities must account for their backwardness, and the forces which have contributed to the progress of other communities have not enriched the village life. The remedial measures suggested by Governments and others who have investigated rural problems offer hopes of speedy improvement in the lot of the village communities.

It seems to us that the problems presented by people who for ages have lived practically in isolation and have carried on rural occupations in unrelieved monotony will have to be investigated from the psycho-physical standpoint before schemes of reform for their uplift can profitably be discussed. We are not thinking of villages which lie within easy reach of administrative centres. The

physical and mental organisation of the people living from antiquity in the remotest recesses of the country may not easily be amenable to the influence of social and economic reform of governments and unemployed graduates, and the problem of these communities may not be identical with those of the more favoured people residing not far from towns. There is no ethnic homogeneity among the rural population and the success of measures devised for their uplift therefore must depend not on the forces exerted on them from outside, but on their sympathetic reaction to such measures. Are the village people thoroughly dissatisfied with their present condition? In what directions do they demand reforms? How far are they capable of supporting schemes of beneficence by their own unaided assistance?

These questions have been answered by Sir Mirza M. Ismail in his illuminating address. "It is barely eight years since the Village Panchayat Regulation was brought into force; yet in these eight years the number of Panchayats has risen from 8,863 to 11,390, the total revenue collected by them has exceeded Rs. 75,00,000 and they have already incurred expenditure exceeding 45 lakhs of rupees. The raising and expenditure of this money has not been an end in itself, but the means of conferring on our rural population a very large measure of village self-government. The Panchayats in Mysore have justified themselves not merely by the works they have undertaken, the roads they have opened, the drinking water and other wells they have sunk, the village parks laid out and the extension of medical and educational facilities, but also by the spirit of public and local pride which they have engendered. The people have come forward in numerous instances to provide weekly communal labour to improve their villages and it has been calculated that the labour so performed would have cost about rupees 10 lakhs if performed by a paid agency." The contribution of Government to the exertions of Panchayats is even more generous and is reflected in the numerous achievements of government departments which have given the villages more tanks for extending cultivation, cheap electric power for pumping installations, industries and lighting. All these schemes form a coherent part of the policy for the promotion of rural prosperity and their fulfilment is only a realisation of the political faith that "governments are called upon to undertake the control in an increasing measure of the economic life of the peoples entrusted to their care".

Mr. Sathianathan's report on the indebtedness in rural areas of Madras delineates the picture of village population in a totally different colour. The agricultural debt in the province is estimated at rupees two hundred crores, an amount equivalent to 20 per cent. of the landed estates. The report throws light on the extent of the cramping influence exerted by indiscriminate and usurious borrowing, on the development of village activities. In a certain measure it must necessarily curtail the grants for reconstructional operations, since a large proportion of the funds will have to be devoted to relieving indebtedness. The worst effect of this heavy burden is that small holdings have passed into the hands of creditors who are unable to continue the agricultural operations and the larger holdings suffer from absentee landlordism capable and willing to advance credits more in the way of investment than as a means of stimulating agricultural operations. The rural problems in a presidency such as Madras must be too complex and difficult to permit of easy solution. Debt rarely fructifies in the hands of the borrower, least of all in those of the agriculturist. Debt Conciliation Boards, if instituted and worked in the spirit in which the Bill for their formation is conceived, the cultivator may find some relief but there is nothing to prevent him from raising fresh loans. The scheme of controlled debt to which reference is made in the report, the essence of which is to provide loans of money and realise them in kind by periodic and expert supervision of cultivation, may assist in keeping the ryot on his land which is undoubtedly a great step in the general movement of rural uplift. Sir Frederick Sykes points out that debts are generally contracted by habits of extravagance and by adherence to expensive customs which the ryot has no courage to withstand. The tendency to take trivial disputes in suits to law courts involves the village population in appalling waste of money, and litigation is more often a fatal enterprise to the villager. The problem of rural reconstructions in large presidencies has a multi-lateral phase and simultaneous attack on all the fronts is proposed by governments and political leaders and the fruits of victory will be

permanent only if the village population actively join the forces initiated for their improvement.

It seems to us that there are certain other ferments stirring village life which must militate against the success of the efforts of even governments to regenerate rural welfare. The people who live in villages not far from the towns come into almost daily contacts with the attraction offered by urban life. Saints and philosophers find it hard to withstand them; the Indian villager has neither the fortitude of the one nor the discipline of the other. The increasing dazzle for town life overpowers him. The expansion of industries offers him reasonable security of engagement, regulated hours of work and protection of labour unions which supervise his education, health and comforts. He welcomes relief from anxieties inherent in his profession, which control over meteorological conditions alone can remove. The large engineering works initiated by the governments, business offices and banks and expansion of places of public amusements and restaurants are slowly absorbing the rural population. As the towns expand industrially and economically the villages naturally contract. How to arrest this depletion of villages is a question now receiving anxious public consideration.

The farmer may be educated. We may provide him with modern implements, credit and expert advice. Facilities may be created for recreation and subsidiary occupations. Every inducement which may be expected to make him happy and contented to remain in his place and cultivate the land can be offered. He finds that his output is governed by new economic laws from which he suffers as acutely in the years of scarcity as in the years of plenty. Agricultural industry is individualised and it is not a syndicate. Without resources of finance and collective power such as well-organised business can always command, agricultural communities being industrialists are confronted with fluctuation of commodity prices arising from "economic depression," "exchange ratio," "tariff rules" and all other phrases and traps. However, the phenomenon of suffering in the midst of plenty is peculiar to modern economic civilisation. The remedy seems to lie in agriculture striking up a new friendship with chemistry for profitable utilisation and disposal of surplus produce. The country which knows no waste is bound to give a new lead to civilisation. The key to rural prosperity is not external padding but research on waste. Science has created poverty amid plenty and science alone can save. It is hard to make the public realise that, but for the vested interests which have grown so immensely round our social and economic problems, science could solve practically every difficulty which confronts governments and private organisations in promoting prosperity and in improving social standard.

The process of recruiting the gifted members of the rural population and other industrial communities to public service may satisfy the principle and policy of communal representation, but it must necessarily impoverish the economic power of even the favoured families. Sir Frederick Sykes pointed out that "we must discard the idea that village betterment depends entirely on forces from without—on action independent of the will of the villager." Who is to supply this will to progress without which all schemes for the spread of material welfare and greater contentment among the agricultural population must be futile, particularly when its educated and forward members are alienated from their traditional occupations and new castes are formed having neither opportunity nor inclination for the scientific study of the development of rural occupations? When those who can revitalise the resources and energies of village life are steadily drafted for other services, the helplessness and crudity of others left behind tend to be perpetuated and the moment we withdraw external assistance, the confusion must worsen the situation. The present position in the villages is a result of the emigration of the more capable individuals of the rural population to town, attracted by inducements for bettering their prospects, held out by government service, industries and business organisations. Education has produced in all communities a thirst for soft appointments in Government Departments, but has not encouraged the spirit of service to the community and pride in family occupations.

Modernisation of Indian villages is inevitable and in order to sustain the improvements and carry it further, it is necessary that the educated young men who have been hitherto looking forward for Government service, should acquire special qualifications for rural reconstruction. An untrained

young man may turn his back on the work he has undertaken on encountering difficulties and disappointments. In several respects the problems of village improvement are technical and their satisfactory solution depends on the aptitude and training which the young men possess. It seems to us that the work of elevating the rural population will be successful if governments could organise special courses of instruction in moral sciences in the universities for the benefit of the people whose prosperity and contentment are the safest insurance of peace and progress of the country, and for the relief of unemployment among young men whose condition engages the anxious consideration of the public and Governments.

Agricultural Research in India.

THE annual report of the Imperial Council of Agricultural Research for the year 1933–34 which has just been published, is a document of absorbing interest, not only because of the large number of special schemes, both scientific and economic, sanctioned by the Council and in progress, but also because of the many more important schemes which are planned or foreshadowed. The large increase in the output of scientific research in Agriculture is an outstanding feature of the progress of scientific research in the country and the Research Council can already claim credit for much of this activity; indications are, as a matter of fact, that it will soon be the greatest single factor tending to the progress of agricultural research, thanks to the liberal grants of money voted by the Central Government for this purpose. The report refers to a temporary cessation of the annual grant owing to financial stringency which has prevented the Council from going forward at the initial pace and which has necessitated the holding up of many a sanctioned scheme. It almost looks as if it was a case of "first come, first served" and that many new schemes had no chance of being considered. A special grant of Rs. 5 lakhs towards the end of the year somewhat improved the situation, though even with this further grant, schemes already approved and costing about Rs. 11 lakhs have had to be kept in abeyance. The list of the schemes already in progress and the amount set apart for each is interesting reading, if at least to show what a vast field remains untouched. Thus out of the 41 schemes in progress, 18 relate to the sugar industry and absorb Rs. 25 lakhs out of a total of about Rs. 45 lakhs. Schemes relating to rice research absorb about Rs. 11 lakhs, and those relating to locust research cost about Rs. 4 lakhs, so that these three subjects alone take up about 90% of the total grant. One need not grudge to the sugar industry which has within the last five years undergone phenomenal development and added largely to the material prosperity of the country as a whole and of the agriculturist in particular, this large measure of help; nor to subjects like rice research and locust research, the substantial proportion they receive by reason of their great importance, but when one compares the bare 10% of the grants which remains for meeting the needs of the large variety of crops and of much-needed development in both crop and animal husbandry, the anomaly of the situation becomes rather striking, and the necessity for a substantial increase in the grants available assumes additional urgency. It is true that much water has flown under the bridge since the period covered by the report and that money has been voted for a number of new schemes, the most notable among which is the one relating to the important subject of the marketing of agricultural produce and the appointment of a chief marketing officer. Furthermore, the needs of one major crop *viz.*, cotton, are being met largely by the mill industry itself through the cotton cess fund, administered by the Indian Central Cotton Committee; a similar cess assists the lac industry; the sugar industry is also in a manner helping itself through the excise duty now being levied; the report, moreover, refers to a proposal for levying a cess on the export of oil-seeds for affording funds for research on the development of the oil-crushing and allied industries in the country. If this latter proposal should materialise, it will mean that one large group of agricultural produce will be meeting its requirements for funds from its own resources. It should, therefore, be possible for the Government of India to set apart substantial sums for research on other important branches of agriculture. As a matter of fact, some of the schemes already sanctioned, such as the marketing inquiry, will inevitably call for a much larger expenditure before long, as each survey discloses lines for suitable practical action.

The Report refers to the formation of

three separate Standing Committees for animal nutrition, cattle-breeding and dairying and also to steps taken for the investigation of important cattle diseases, during the year. The latter certainly demands much greater attention and one can hardly think of a more fruitful field for the Council's help. The livestock industry in the country is already a huge one and as the years go by, is bound to assume still greater importance from the point of view of increasing the earnings of the ryot and of improving the nation's food supply; but one of the greatest handicaps to progress is the prevalence of disease which threatens the industry on its present scale itself; while expansion or improvement in respect of breeds whether it be cattle, sheep or poultry is practically out of the question. The veterinary staff in the provinces has neither the time nor the facilities for anything beyond the routine of a general practitioner, and such research facilities as exist at the Muktesar Institute and in some of the Veterinary Colleges and Serum Institutes are disproportionately inadequate for the needs of the country. A Central Institute for this purpose, well-equipped and staffed, is a crying need and forms a legitimate demand upon central revenues. This, of course, does not rule out assistance to the provinces and existing institutions conducting researches such as the present provision of Rs. 2 lakhs for the investigation of tuberculosis and Johne's disease. We wish the scheme of sheep breeding, referred to in the report, took precedence over some others, or, was accorded special treatment and proceeded with, for the possibilities are admittedly great and the subject has been relegated to the background for a very long time. As it is, a sum of Rs. 85,000 is said to have been sanctioned for a scheme which, however, had to be kept in abeyance for want of funds. A beginning is said to have been made in the matter of registration of pedigree stock of dairy and draft cattle; a revised and uniform classification of cattle for purposes of the quinquennial cattle census has been approved by the Advisory Board, which is an improvement on the present form; a recommendation fixing a three years' course with F.Sc. as an entrance qualification in the Veterinary Colleges and a curriculum suitably revised for the course was also approved by the Board, in the Animal Husbandry Section.

In the section of crop industry, work on sugarcane occupies, as already indicated, the most important place. A chain of eight research stations in Upper India and three located in Bombay, Madras and Mysore have carried on work relating mainly to the breeding and testing of superior varieties and incidentally to other aspects of cultivation such as, manuring, irrigation and methods of jaggery making. Work on the improvement of the indigenous methods of sugar manufacture has received considerable attention as likewise the methods of jaggery making. In the face of the competition from sugar made in large-scale factories whose efficiency is being rapidly improved we doubt if the old-fashioned *Khandsari* sugar has any chance and if it is worthwhile spending money over improvements in the methods. The case of jaggery is however quite different, for not only does this product come in as a class by itself and distinct from sugar but it forms about the only outlet for the cane crop in many parts of the country which for various reasons cannot be thought of for sugar manufacture on a factory scale. Better extraction, cheapening the cost of manufacture and improvement in the appearance and keeping qualities of the jaggery, will all make it a more remunerative proposition, and afford scope for considerable research work. We would also add that the prospects of manufacturing raw sugar or refining crystals in preference to jaggery in some at least of the jaggery-boiling centres, deserves to be investigated. The appointment of a geneticist for the cane-breeding station at Coimbatore and the strengthening of the mycological staff at Pusa for the investigation of mosaic and other diseases of sugarcane during the year, are noteworthy, as likewise is the approval by the Board of a scheme for the study and control of insect pests on sugarcane. Knowing as one does how serious the position is in these matters, a more welcome feature of the year's work on sugarcane can hardly be thought of and we hope this pest control scheme will be taken up without further delay. The enquiry into the cost of production of crops in the sugarcane and cotton growing tracts in India has not been undertaken any too soon and one can say from personal knowledge that the results are sure to throw a good deal of light on a subject of great importance in the economics of agriculture on which opinions at present are vague and often contradictory. It is a matter of

gratification that the Council has boldly embarked upon this inquiry notwithstanding its cost and despite perhaps the opinions of doubting Thomas's about its value.

Research on rice occupies the pride of place, judged by the expenditure sanctioned, among the other schemes. It is a comprehensive all-India scheme costing Rs. 11 lakhs, spread over a period of five years. Work, however, seems to have related mainly to the breeding and testing of varieties which most provincial departments are already engaged upon, but the grant is said to have enabled the departments among other things, to widen the range of varieties handled. We may, perhaps, single out the work in Burma for special mention, for it relates to the development of strains of rice suitable for the English and European markets and leading therefore to an expansion in the foreign trade in rice. The period of five years is too short for the work in view, and we feel certain, that the need for continuing the scheme will have to be faced. While on the subject of foreign markets for Indian produce, we may draw attention to the collection and circulation of information by the Council during the year regarding the quality of the different kinds of produce, notably oil-seeds, which enjoy a preference in the United Kingdom markets under the Ottawa agreement, which will enable them to compete with non-empire produce and will make the preference really operative. We are glad that as an all-India organisation, the Council has been fully alive to the importance of this matter and is closely watching the working of this commercial agreement in the interests of Indian agriculture.

It is rather disappointing that in respect of tobacco where the scope for improvement with a view to meeting the local demand for cigarette tobacco and also producing enough for an export trade is very considerable, the Council could not do more than appointing another committee. We hope this committee's work will lead to practical action very soon, among which we may suggest suitable financial help to provincial departments undertaking the cultivation of the special varieties and the curing and conditioning of the produce according to up-to-date methods.

Among the minor activities of the year, we may refer to the subject of statistical studies in agricultural research and the help afforded by the Council in the training of agricultural officers in these methods. The field trials and the interpretation of the results stand to gain in accuracy and already the effect of the training is noticeable in the studies and publications of many of our experiment stations. The initiation of studies in agricultural meteorology is another important development to the credit of the Council and considerable work has been done especially in correlating crop yields to meteorological data and in the evolving of suitable instruments and of technical methods. Weather Bureaux elsewhere have been of such great assistance to farmers that we can expect our own organisation also to play a similar rôle, provided the staff is strengthened so as to secure co-ordination with the existing meteorological stations in the different parts of the country.

It will be impossible to refer even briefly to all the schemes and other activities of the Council. The oil technology work and the work on the utilisation of molasses at the Harcourt Butler Technological Institute, the work on the utilisation of town refuse and farm waste for manure at the Indian Institute of Science, potato breeding on the Nilgiris, inquiry into the trade in cocoanuts and cocoanut products, locust research, water hyacinth control, dry farming schemes, goat keeping, 'quality' in crop investigations, malting of cholum, fruit research schemes, research on virus diseases, are some of the schemes referred to in the Report. As already indicated, however, nearly all the schemes have been going on only for short periods and some have hardly begun. Moreover the Report itself, latest as it is, appears to be very incomplete; so rapidly have the activities of the Council been expanding and so many are the new schemes taken up since the period covered by the Report. The Council is gradually approximating in scope and organisation to the Federal Department of Agriculture in the U. S. A., and we have no doubt that the Council will succeed in doing as much for our agriculture as the U. S. Department is doing for the American farmer.

Poverty amidst Plenty.

THE paradox of Poverty amidst Plenty has become almost a platitude by iteration. Nevertheless the conscience of thoughtful people continues to be disturbed. Why is food thrown into the sea when

millions are ill-nourished? Why is cotton ploughed into the soil when millions are ill-clad? There are those who blame the discoveries of modern science for this trouble, the means of production have vastly increased while distribution has lagged behind. The problem would seem indeed to be largely a question of time-lag. Part of the world is living mentally in the age of the bullock cart, part in the age of the aeroplane. Thus the financial world is still largely governed by the ideas of a pre-scientific era and is therefore ignorant of the implications of modern science. The scientific worker, on the other hand, is little concerned with the world of finance and the possible results of his own discoveries, in relation to the public welfare.

It is satisfactory, therefore, to note that at last the scientific world is waking up to the need for the realisation by scientific workers of their responsibility for the wider aspects of human welfare, lest science itself shall come under condemnation. A recent letter of protest against the misuse of scientific discovery has appeared in the press bearing the signature of the President of the Royal Society and a number of other distinguished names. Sir Richard Gregory speaking recently at a Rotary luncheon at Norwich made an eloquent plea for the right use of the gifts of science, and looked for the time when science would no longer be thought of as a destroying angel but as the herald of a more abundant life.

Following a recent discussion at Oxford on "Academic Freedom", reported in the August number of the *Journal of the Institute of Chemistry*, a resolution was passed to set up a Committee with the object of seeing that so far as possible science should be used only for the benefit of humanity. Of even greater significance than protest and eloquence is the fact that a representative body of engineers and scientific workers of the British Science Guild have formed themselves into a group to study the problems of modern economics and these studies have resulted in the publication of a highly valuable document entitled "First Interim Report on Schemes and Proposals for Economic and Social Reforms". No fewer than 24 proposals have been carefully studied and their essential features tabulated. Among these proposals may be specially mentioned:—

Sir Basil Blackett's "Planned Money",
Proposals of the Communist Party,
Conservative Party Proposals,
Douglas Social Credit Proposals,
The Proposals of Silvio Gesell ("Free Economy"),
The London Chamber of Commerce Proposals,
Professor Soddy's Proposals, and
The Proposals of the Continental Committee on Technocracy.

The British Science Guild have published other pamphlets of scientific and economic interest among which may be mentioned "The Electron Liberated: Its Industrial Consequences", by Clifford C. Paterson, O.B.E., M.Inst.C.E., M.Inst.E.E., and "Human Biology and Politics" by Professor J. B. S. Haldane, M.A., F.R.S.

This activity among scientific workers may help to lay a true foundation for a new world where every hungry mouth has enough to eat, every capable hand enough work, where exploitation in the name of business is unknown and where peace and sufficiency reign supreme.

The appeal made by Dr. Fowler in his recent paper entitled "Energy and Economics" which appeared as a supplement to the May number of *Current Science*, calling for greater attention on the part of scientific workers to the problems of modern economics, has our warm support, and we hope to return to the subject in a later issue.

Rajasabhabhushana Sir Chandrasekhara Venkataraman, Kt., F.R.S., N.L.

Director, Indian Institute of Science, Bangalore.

HIS Highness the Maharaja of Mysore was graciously pleased to confer the title of "Rajasabhabhushana" on Sir Venkataraman at the recent Dasara Durbar held in Mysore. We have great pleasure in congratulating Sir Venkataraman on the glittering decoration bestowed on him. Palace honours are usually reserved for officers rendering distinguished service to the State, and the titles connote the merits and accomplishments of recipients. But in the case of Sir Venkataraman, all laurels become his brow. His Highness's generous act will be widely appreciated.

Geochemistry and Biochemistry.

By Prof. A. P. Vinogradov.

(*Biogeochemical Laboratory of the Academy of Sciences, U.S.S.R.*)

I.

UNTIL quite recently, it was generally believed that organisms—plants and animals—consisted of a very limited number of chemical elements.

This view has, now, to be abandoned, since 60 chemical elements have been discovered in one or the other of the organisms; it is, perhaps, easier to name those chemical elements which have not been found in organisms or about which indications are unreliable. The chemical elements not yet discovered in organisms may be referred to five groups: (1) the radioactive elements Pa, Ac, Po and the numerous radioactive isotopes*; (2) the rare-earth metals—Tl, Eu, Gd, Tb, Dy, Ho, Er, Tm, Il and Lu; (3) the inert gases He, Ne, Kr, X; (4) the elements of the platinum group: Ru, Rh, Pd, Os, Ir, Pt §; and (5) of all the other chemical elements: Te†, Zr†, In, Ta, Hf, Ma, Re, 85† and 87†.

This list shows with sufficient conclusiveness the present position. For the majority of the chemical elements named, there are yet no simple and sufficiently sensitive and accurate methods of determination. It may be conjectured that these elements may be found in organisms only in negligibly small amounts.

Nevertheless, the constant finding of one or the other chemical element, often in small amounts (in thousandth, millionth and lesser parts of a per cent.; they may, therefore, be called microelements), in the tissues of organisms, was not a convincing indication for biochemists, of the important physiological part of those "traces" of microelements. Scores of years were required after I, Cu, Mn, B and many other microelements were found in organisms, to recognise their important rôle in physiology.

The exceptional interest of the question of the physiological rôle, in particular, of microelements present in the tissues of organisms, arose recently among biochemists (physiological function of Cu, F, B, etc.) and especially among agrochemists (importance of B, Cu, I, etc. for plants).

As in the past, the many-sided researches in this direction, which are conducted by various specialists, physiologists, biochemists, chemists, agrochemists, mineralogists, etc., are being carried out along different paths, and pursue quite different objects. Owing to this there has occurred a certain break. The unique common phenomenon—the process of shifting matter, the *biogene migration* of atoms in the complex *indissoluble system —soil—soil solution—plants—animals*,— was lost sight of by these investigators.

II.

Not less persistently, is the view held that the *chemical elementary composition of organisms* does not represent any differences as to species, genus, etc.; that it is not constant and is subject to considerable variations. In other words, we cannot definitely consider it proved, that the chemical elementary composition of organisms is a specific character. It must be noted, however, that from this point of view, the subject has not been systematically investigated.

The study of the chemical elementary composition of living organisms has been, in a way, the special interest of the physiologist, biochemist, agrochemist and mineralogist. The importance of the problem is only being recognised at present. And, nevertheless, many scores of thousands of analyses of various organisms made during a period of more than a century, by agronomists, biologists and mineralogists, on closer examination, contain direct proof of special features, and of a certain constancy in the chemical elementary composition of species.

For instance, the differences in the contents of phosphorus and nitrogen in plants and animals are very well known. Among organisms are known to us numerous species,

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* Besides MsTh, see works from our Laboratory—V. Vernadsky, B. Brunowsky and Kunaseva, *Compt. Rend. d. Sci. Acad. Paris*, 1933, T. **197**, 1556.

§ It is of interest to note that Ge was discovered in organisms recently by V. M. Goldschmidt within the ranges indicated in the curve. Into the maximum enters Ru, one of the elements of the platinum group, which forms soluble compounds more easily than others. In the smallest amounts is probably found Th.

† Indications not checked, but their occurrence in organisms is known.

which concentrate definite chemical elements in considerable amounts. We are familiar with the division of plants into the calcareous and siliceous ones. Among the latter are, for instance, the grasses, sedges, horsetails, and diatoms. We know perfectly well the typical iron-organism (also that of manganese, sulphur, etc.); the halophytic flora (Na and Cl), numerous hydrophites, which collect considerable amounts of aluminium ‡ (marine and fresh water algæ, many aqueous phanerogamous plants—monocotyledons, bacteria, etc.), and the like.

In relation to many chemical elements it might be possible to indicate typical organisms—concentrators. It is possible to easily discover the peculiarity of the chemical elementary composition of definite species of living organisms by comparing the composition of different plants for which numerous determinations have been made, especially for the composition of their seeds. In the Biogeochemical Laboratory of the Academy of Sciences of USSR investigations were made on the chemical elementary composition of 13 species of *Acridiidæ*, collected from various localities during a period of three to four years. These data have shown a complete stability of the composition of *Acridiidæ*, its resemblance to proximate species and very great distinctions from the chemical composition of other insects. Sometimes, in animals, the definite occurrence of only one chemical element acquires a specific character. For instance, investigation of 20 species of ants has shown us, that the species of the family *Camponotinæ* contain Mn of an order N. 10^{-2} per cent. but species of the family *Myrmicinæ* of an order N. 10^{-3} per cent., while the more primitive family *Ponerinæ*, as it seems, contains still less Mn. Another instance: ascidians are rich in vanadium. They are typically vanadium-organisms. Nevertheless, as we have shown, not all the species of ascidians concentrate vanadium. Species from the families *Ascidiidæ*, *Cionidæ*, *Botryllidæ* and some others concentrate vanadium, whereas the majority of species from the families *Tethyidæ*, *Melgulidæ*, *Synoicidæ*—do not contain any marked amounts of vanadium. Similarly, among the families and genera of living organisms rich in vanadium, manganese, iodine, copper, etc., are distinguished species exceptionally rich in one or the other chemical element. The number of such instances may be multiplied. We have quoted them in our work on the chemical elementary composition of marine organisms.

Fluctuations observed for the chemical elementary composition of organisms may be accounted for as being due to age, season, sex and ecological factors. The individual fluctuations of the chemical elementary compositions recall similar fluctuations of the morphological characters in organisms.

Thus, there certainly exist typical differences in the composition of definite species, genera and other taxonomic units.

The chemical elementary composition of organisms is a species character.

III.

The chemical elementary composition of organisms or the finding of one or of another element in the tissue of these organisms has been studied by biochemists, as a rule, outside its natural environment—the biosphere.

Between the environment and the organisms there occurs, uninterruptedly the exchange of matter—the environment and the organisms are closely connected by the common history of the atoms of the chemical elements. *Living matter* (totality of all organisms) during more than one million years has shown enormous geochemical activity, by concentrating various chemical elements, by playing a considerable rôle in sedimentary rock formation. In the chemical composition of each organism we encounter the expression of a definite geochemical part played by the given species of living organisms. From a geochemical point of view, some *geochemical functions* are inherent to all organisms—in some the calcareous geochemical function predominates, in others the siliceous or phosphate one, and so on; and, finally, several such functions may take place together. The chemical elementary composition of organisms and therefore the range of participation of the organisms in the biogene migration of the chemical elements in the biosphere cannot be left without attention when studying the geochemical laws of the distribution, combination and migration of atoms within the earth's crust. For the first time, the *biogeochemical* ideas indicated were stated with exceptional vividness by Prof. V. I. Vernadsky. From that moment the question of the chemical elementary

‡ Contemporary *Licopodiocca* are rich in Al. Probably the fossil *Lepidodendron*, which are closely related to the latter, were also rich in Al. Their coal is rich in Al.

composition of organisms acquired a full scientific value. And the closer we approach it, the more obvious becomes the fact that the general geochemical laws, governing the distribution and combination of the chemical elements in the earth's crust govern also all living matter.

IV.

We have got accustomed to the biogene migration of atoms between organisms and environment, which is occurring in the biosphere during scores of thousands of years. We do not notice this close, indissoluble, unchanging (within historical time) connection between them. It becomes manifest as soon as a disturbance occurs.

We often come across such biogeochemical phenomena.

The *deficiency* or *excess*, as compared with the usual presence in the environment, for instance in soils, of some definite chemical elements, owing to the peculiarity of the geochemical history of the given locality, calls forth, over tremendous areas, a change of the qualitative and quantitative morphological composition of the soil cover and of the animal world connected with it. It is well known, for instance, that the deficiency of Ca, P, (for instance, in soils originating from granite) calls forth a disturbance in the composition of the flora. Thus, for instance, the grasses of the Savannahs and steppes experience phosphate hunger, etc., and in their turn the steppe animals, cattle from the pastures, become sick because of deficiency of phosphorus (and lime) (inflammation of the bones, "brittle bones"). Those phenomena are observed also on cultivable soils throughout the whole world. The deficiency of Fe (and Mn) in the soil leads to sickness of both plants and animals. Perfectly well known is the spread of endemic goitre among men, cattle, birds, fishes, etc., in localities with a deficiency of iodine in the soil, drinking water, etc. At present, in many countries (Holland, Germany and others) are known soils demanding Cu for the successful growth of crops. The absence of Cu in the feed, appears to cause in cattle a special sickness (licking disease). Many soils, as it has now become evident, demand for the normal growth of some crops—leguminous plants, flax and the like—a definite amount of boron. On the contrary a certain excess of one or another chemical element in the soil, leads to similar *geochemical provinces* occupied by peculiar *biogeochemical endemies*. We know of Se, As, and other "poisonings" of some soils. The excess of F in soils, soil waters, in drinking water in many countries—U. S., Algiers, Tunis, and others—causes an endemic disease of man, the so-called "mottled enamel", and so on. Much in this direction we still do not know. Similar biogeochemical endemies connected with the presence in the soils of Zn, Al, serpentine and others have a lesser range. All this leads to the formation of peculiar variations in some definite plants from these soils. It seems to us that the existence of regions (soils) with an unusual content of some chemical elements, forming geochemical provinces or separate "spots", should prove a kind of hindrance for the spreading of definite species of organisms.

Therefore, such geochemical provinces have the property of a selecting and transforming factor for organisms. In the process of their life and evolution, plants and animals in their turn (in a geological sense) lived on a definite substratum which formed only one of the stages.

Thus, it seems to us, that in each *species of organisms are concealed the chemical characters of their origin.*

The study of the chemical elementary composition of organisms from a geochemical point of view helped us to arrive at some general conclusions. The average chemical composition of living matter may be graphically expressed in the form of a curve (see Fig. 1). Comparison with similar curves for the distribution (frequency) of *atoms* in the soils, earth's crust, living matter, etc. shows that at their basis lies one general law of quantitative distribution of atoms. However, they differ in details. Each of the paragenetic spheres (living matter—biosphere) is characterised by its peculiarities. We see from the curve for the distribution of chemical elements in the living matter that: (1) the number of atoms of chemical element in the living matter is in inverse proportion to its atomic number (atomic weight). In other words, the chemical elementary composition of the living matter, as a whole, is definitely related to the number of charges on the nuclei (protons). (2) The curve shows a regular periodicity (6 and 8) with definite maxima and minima, representing certain regular deviations from the hypothetical inclined curve (which may be traced from H to U). Periodicity for the number of atoms in living matter is

Chemical Elementary Composition of Living Matter (in per cent atoms).

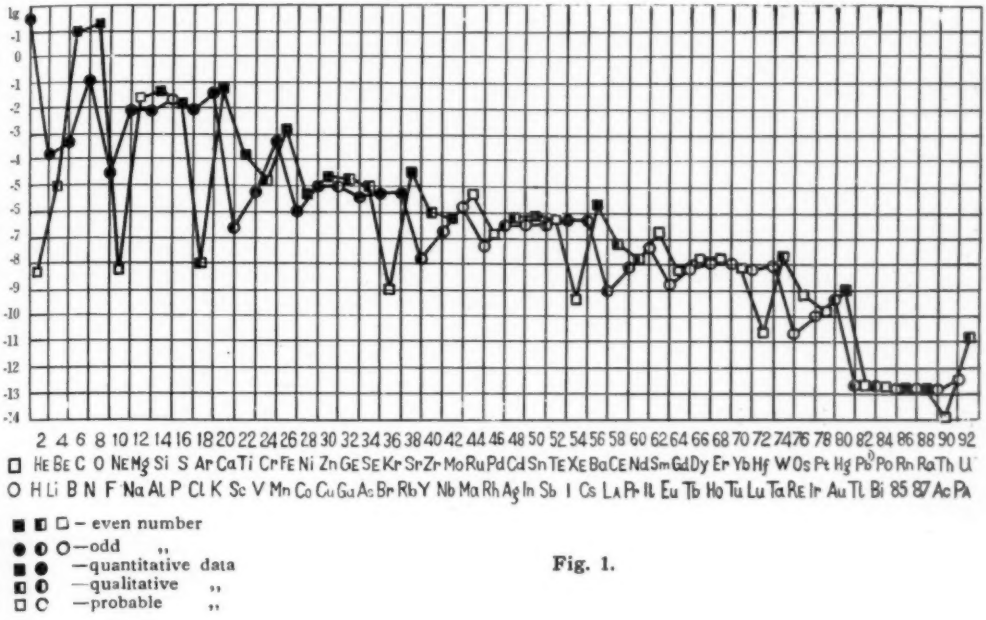


Fig. 1.

accurately observed within the ranges of the first 50–60 elements, for which experimental data exist. The curve can be extended further; few data exist for the remaining chemical elements—Au, Hg, Ra, Th, etc. (3) The chemical elements which occur in maximal quantities play the chief part in the composition of organisms. In relation to those elements numerous organisms—concentrators,—are known. They are especially varied and numerous among the representatives of ancient groups of organisms (*Tallophyta*, *Protozoa*, etc.). The elements, occurring in minimal quantities, are not concentrated by organisms. From a geochemical point of view those elements—inert gases, Hf, Zr, Th, Rh, Se, partially Ti, and others—are characterised by a nearly complete absence in them of the capacity to form soluble compounds (in soil, etc.)* in natural conditions.

Thus the range of deviation from the straight inclined line (appearance of maximum and minimum) for different elements depends on the chemical properties of atoms (outer electrons of atoms). Therefore, those maxima and minima occurring in definite species find places on the curve and although they may vary in the position, they nevertheless do not disturb the general periodicity of the curve.

In the future a more detailed study of the distribution of the chemical elements in the organisms from a geochemical point of view shall allow biologists, physiologists, agronomists, geochemists, etc., to tackle important problems of natural science using a common scientific language.

REFERENCES.

1. V. I. Vernadsky, *La biosphère*, 1930, Paris.

2. *Idem*, *Geochemistry*, 4th Edition, 1935, Moscow. Extensive literature quoted (in Russian). *Idem* in German—*Geochemie in ausgewählten Kapiteln*, 3rd Edtion, Leipzig, 1930.

3. A. P. Vinogradov, *Transact. of the Biogeochemistry Laboratory*, 1935, **3**, Leningrad-Moscow.

4. *Idem.*, Vol. IV (in the press).

5. Works of the Laboratory are printed in *Transact. of the Biogeochemistry Laboratory* and in the *Compt. rend. de l'Academy d. Sc. USSR.*, 1926-1935.

Some Recent Work on Isotopes and Hyperfine Structure of Spectral Lines.

By Prof. B. Venkatesachar, M.A., F.Inst.P.
Department of Physics, University of Mysore.

THE chemical and physical properties of an element are in the main determined by its atomic number. All elementary substances having the same atomic number but different mass numbers constitute a group of isotopes and occupy the same position in the Periodic Table. According to this definition of an isotope, H^2 (deuterium) and H^1 (ordinary hydrogen) are to be considered as two isotopes of hydrogen. Here, however, the difference in properties between the two isotopes is more marked than with other isotopes. This difference results from the pronounced inequality in the masses of H^2 and H^1.

The isotopic constitution of elements has been investigated mostly by Aston, Dempster and Bainbridge with the aid of mass spectrographs, each using an instrument of his own design. In all these instruments a mass ray containing charged atoms of the element has to be produced. For the production of such rays the existence of suitable volatile compounds frequently becomes a necessary preliminary condition. The search for such compounds has retarded the successful isotopic analysis of several elements. Of such elements palladium, iridium, platinum and gold stand prominent.

Hyperfine Structure of Spectral Lines.

Spectral lines which appear single in spectroscopes of low resolving power often exhibit a structure when instruments of high resolving power are used, *i.e.*, in place of a single line a group of lines with small differences of wave-lengths is seen. Pauli was the first to make a fruitful suggestion to account for the hyperfine structure. In the light of subsequent theoretical development the suggestion of Pauli is equivalent to attributing a spin to an atomic nucleus: the interaction of the resulting nuclear magnet of comparatively small magnetic moment with the rest of the atom considered as a magnet would have the effect of splitting multiplet levels into bunches of close levels, the resulting transitions giving rise to the observed hyperfine structure. Taking I to represent the nuclear spin moment and J, the resultant mechanical moment of the rest of the atom, there will result $2I+1$ or $2J+1$ hyperfine levels according as $J>I$ or $I>J$. It is found that only isotopes with odd mass numbers have a nuclear spin, the even isotopes having zero spin moment. Though the spin of the even isotopes is zero they do not give rise always to coincident spectral levels. The separation of the levels in any case due to the even isotopes is called even isotopic displacement (Fig. 1). In the case of an odd isotope for purposes of evaluating isotopic displacement the centre of gravity

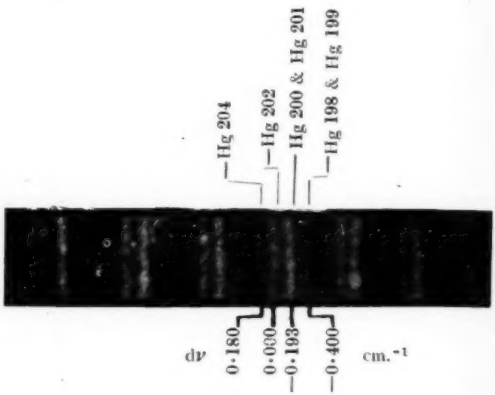


Fig. 1.
Structure pattern of Hg II 2262·33Å
($5d^9\ 6s^2\ ^2D_{5/2} - 5d^9\ 6s\ 6p\ ^2D_{5/2}$) showing isotope displacement.[1]

of the hyperfine levels is taken. This displacement of levels has an origin different from that due to a change in the mass of the nucleus in the expression for the Rydberg constant, the latter may be called a pure mass effect. It may be remarked that the doubling of the lines in the atomic spectrum of a mixture of H^2 and H^1 has its origin in the variation of the nuclear mass, in other words it is a pure mass effect.

In the laboratory of the author investigations on the hyperfine structure of the lines of the elements palladium, iridium, platinum and gold were undertaken with a view to determine their isotopic constitution and the nuclear spins of the odd isotopes. Sufficient theoretical and empirical information regarding the nature and origin of the hyperfine structure to enable one

[1] Venkatesachar and Sibaiya, "Hyperfine Structure of some Hg II lines," *Proc. Ind. Acad. Sci.*, **1934, 1, 8.**

to make such determination is available provided the structure patterns can be photographed without complications arising from self-reversal. Since the significant lines for this purpose arise from transition to the ground-level or levels very near it, avoidance of self-reversal becomes a matter of some difficulty. The following arrangement of apparatus has been evolved for the purpose as the result of a considerable amount of investigation.[2]

DESCRIPTION OF APPARATUS (Fig. 2).

The hollow cathode employed in this investigation is a double-walled copper cylinder hard-soldered at both ends with the inside hollow about 1 cm. in diameter and 6 cms. in length. Inlet and outlet tubes are provided so as to maintain a continuous flow of water in the space between the two cylinders during excitation. On to the shoulders cut in the outer copper cylinder are fitted pyrex glass tubings with a quartz window on one side and a ring anode on the other. The metal glass joint is rendered air-tight by Apiezon sealing wax and due to the continuous flow of water in the hollow cathode the joint continues to be air-tight under all conditions of discharge. The apparatus is set up *in situ* with a thin cylinder of the metal under investigation fitting tightly in the hollow cathode. The apparatus is next exhausted with a mercury diffusion pump backed by a Cenco Hyvac pump. The backing pump is then cut off and the activated charcoal is cooled by liquid air contained in a triple wall Dewar cylinder. Helium is now let in slowly, further purification being effected by its passage through the liquid air-cooled charcoal. When the required pressure of helium (about 1 or 2 mms. of mercury) is reached the supply is cut off. Requisite amount of helium is thus allowed to circulate continuously through the hollow cathode by the operation of the diffusion pump. The repeated passage of helium through the liquid air-cooled charcoal maintains its purity. A direct current dynamo of 1 kilowatt capacity is employed to send a discharge through the hollow cathode. For the excitation of the arc lines a discharge current of 150 mA at 1500 v. is found satisfactory. At this stage the hollow cathode glow is intense and is accompanied with little or no positive glow. The discharge conditions can be maintained steady for hours together by replenishing the liquid air from time to time.

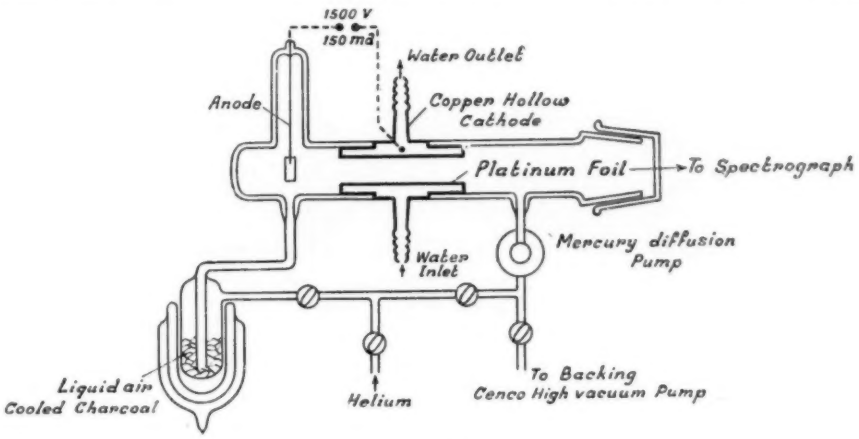


Fig. 2.
Hollow Cathode Source.[2]

The hollow cathode glow is concentrated on a Hilger Lummer Gehrcke plate of quartz (3·45 mms. thick and 20 cms. long) by means of a quartz lens carrying a double-image prism. One of the images is cut out and the light of the other, with its electric vector parallel to the plate, passes through. The pattern is focussed by a quartz achromatic lens on to the slit of a Hilger E1 spectrograph with a quartz train. The hyperfine structure patterns of the arc lines are

[2] Venkatesachar and Sibaiya, "Platinum Isotopes and their Nuclear Spin," *Nature*, 1935, **136**, 65; *Proc. Ind. Acad. Sci.*, 1935, **1**, 955.

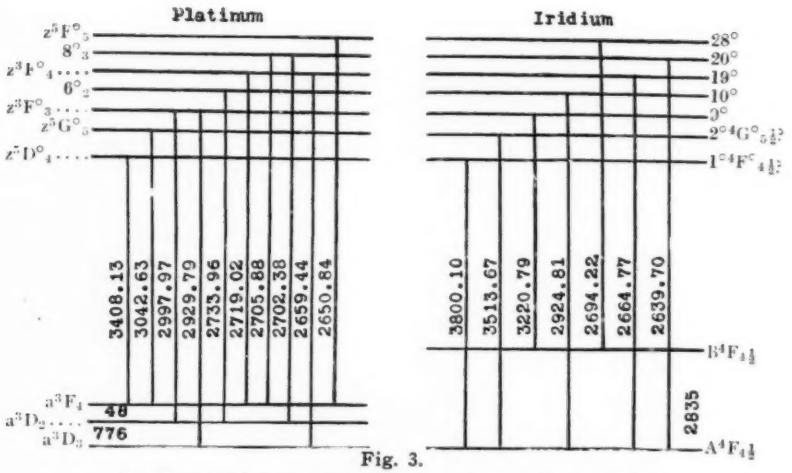


Fig. 3.

Arc lines of platinum and iridium analysed. (Not to Scale.)[4]

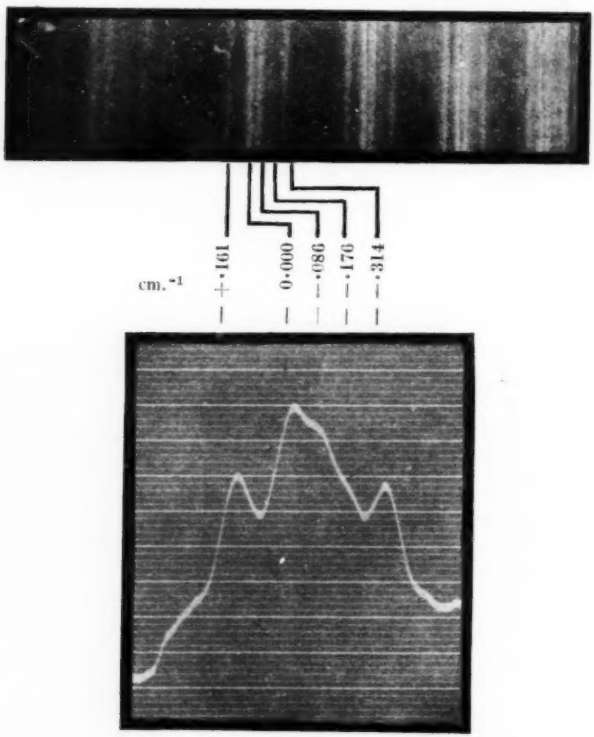


Fig. 4.

Structure Pattern of Pt I λ 3408·13 Å with Microphotogram.[2, 3]

photographed on hypersensitive panchromatic plates. The advantage of the experimental arrangement used is that only the lines cor-

responding to transitions to the ground-level or to the levels close to it are excited without introducing complications arising from self-reversal. From the standpoint of hyperfine structure analysis these are generally the significant lines. For platinum and iridium the transitions giving rise to the lines excited are shown in the diagram above (Fig. 3).

Platinum.—The photograph of the structure pattern of the line Pt I 3408·13 A ($a\,^3F_4 - z\,^5D^\circ_4$) has five components. In interpreting this pattern, the structures of other lines of platinum have been taken into account.[2] The result of the examination is that the extreme components on either side are due to the odd isotope of mass number 195 with a nuclear spin of $\frac{1}{2}$ and the three inner components are due to the even isotopes of mass numbers 196, 194 and 192. The relative abundance as deduced from measurements on a microphotogram (Fig. 4) is as follows[3]:—

Mass number ..	196	195	194	192
Relative abundance	16	13	10	2

Dempster has recently published* the isotopic constitution of platinum obtained by using a spark discharge between platinum electrodes and a new type of mass-spectrograph. He finds five isotopes; according to him the isotopes 194, 195 and 196 are nearly equal in abundance, isotope 198 is distinctly less in abundance and isotope 192 occurs in very small amounts. One would infer from this that the component ascribed to 192 may be due to the isotope 198 recognised by Dempster. This, however, would give a negative isotope shift instead of a positive one. The centre of gravity of the lines due to an odd isotope lies usually nearer the line due to the lighter even isotope. This rule would be violated if the faint component in the pattern of 3408 A is attributed to isotope 198. The isotopes 194 and 196 are however markedly unequal in abundance and cannot be said to be nearly equal as would appear from the communication of Dempster to *Nature*.

Iridium[4].—The structure pattern of the line Ir I 3513·67 Å ($5d^8\,6s\,^4F_{4\frac{1}{2}} - 5d^8\,6p\,^4G^\circ_{5\frac{1}{2}}$) is shown in the photogram (Fig. 5). The relative intensities and number of the hyperfine components in the patterns of the lines

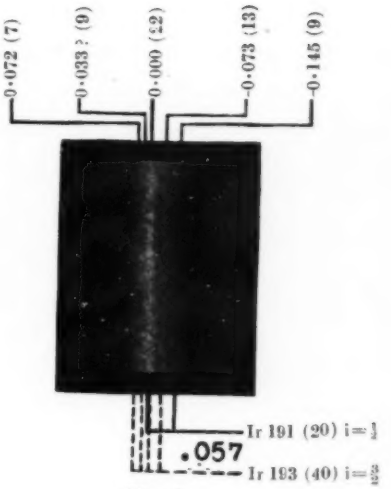


Fig. 5.
Structure pattern of Ir I λ 3513·67Å.[4]

examined and the fact that iridium is an element of odd atomic number with its atomic weight in the neighbourhood of 193 leads to the unique interpretation that iridium consists of two isotopes 191 and 193 with a relative abundance of nearly 1 : 2. The nuclear spin of the isotope 191 is $\frac{1}{2}$ and of 193, $\frac{3}{2}$. Isotope 193 gives rise to the four dotted components *a*, *b*, *c* and *d* shown in the figure and isotope 191 gives rise to the two "full" lines A and B in the case of λ 3513·67 Å (Fig. 6).

Palladium.—Using the apparatus above described, Sibaiya who has collaborated with the author in this work has examined the hyperfine structure of the arc lines of palladium and gold.[5] Analysis of fourteen arc lines of palladium belonging to the transitions $5s\,^{1,3}D - 5p\,^{1,3}(P, D, F)$ has revealed an absence of structure in the lines leading to the inference that none of the levels concerned shows any even isotope displacement. An examination of known isotopes in the neighbourhood of palladium indicates that an odd isotope of mass 105 should exist in palladium. The hyperfine structure data show that the percentage abundance of this isotope exceeds 10%, and that its nuclear magnetic moment is small. The nuclear spin of Pd 105 cannot be fixed with certainty but the value $\frac{1}{2}$ is probable. The absence of even isotope displacement in

[3] Venkatesachar and Sibaiya, "Isotope Abundance in Platinum," *Proc. Ind. Acad. Sci.*, **1935, 2,** 101.

* *Nature*, **1935, 135,** 993.

[4] Venkatesachar and Sibaiya, "Iridium Isotopes and heir Nuclear Spins," *Proc. Ind. Acad. Sci.*, **1935, 2,** 203.

[5] Sibaiya, "Hyperfine Structure in Selenium, Palladium and Gold," *Proc. Ind. Acad. Sci.*, **1935, 2,** 313.

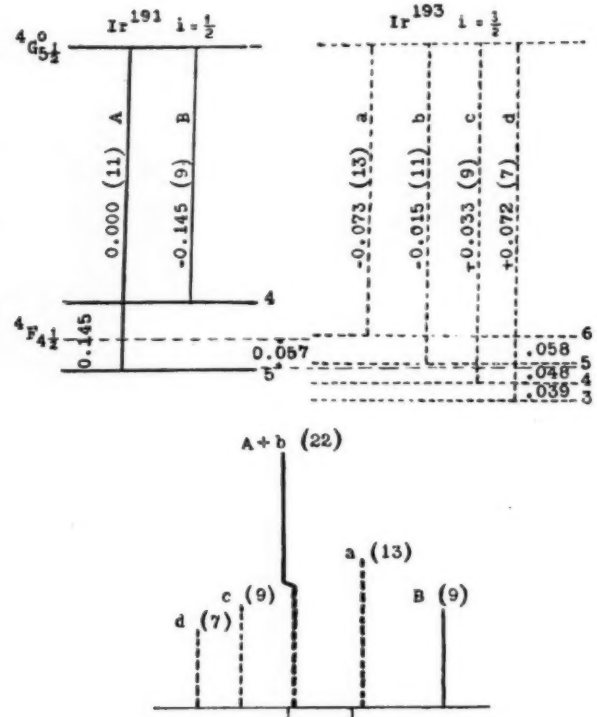


Fig. 6.

Ir I λ3513.67 Å ($5d^8 6s\ {}^4F_{4\frac{1}{2}} - 5d^8 6p\ {}^4G^o_{5\frac{1}{2}}$)[4]

palladium has rendered the determination of its isotopic constitution from a study of the hyperfine structure of its arc lines alone not possible. Recently Dempster has reported† six isotopes for palladium with masses 102, 104, 105, 106, 108 and 110. The four middle isotopes are nearly equal in abundance, while Pd 110 is markedly less abundant and Pd 102 is the least abundant in the group.

Gold.—Arc lines of gold involving the level $5d^9\ 6s^2\ {}^2D_{5,2}$, which shows large isotope displacements in the isoelectronic spectrum of Hg II, have been analysed. The results show definitely that gold consists of a single isotope of mass 197 with a nuclear spin of $\frac{3}{2}$ and a nuclear magnetic moment of 0·20. The accepted chemical atomic weight of gold suggests however that gold must have another isotope of mass 199; known facts regarding the occurrence of odd isobares, along with the hyperfine structure data, point to the conclusion that Au 199 is entirely absent. Thus it follows that the chemical atomic weight of gold is too high. The more recent mass-spectrographic results of Dempster corroborate the above conclusions. The experimental value of the nuclear g(I) factor, *viz.*, 0·136, is in good agreement with Landé's theoretical value, 0·133.

In conclusion one may remark that platinum, iridium and gold are perhaps the only elements, whose isotopic constitution has been first revealed by a study of the hyperfine structure of the spectral lines.

† *Nature*, 1935, **136**, 65.

Tree Ring Dating of Archæological Finds.

By R. Maclagan Gorrie, D.Sc.
(*Indian Forest Service.*)

THE reactions of the annual rings of wood laid down in the ordinary process of a tree's growth have been known for long to show some definite relationship to the climatic conditions under which the tree has grown. The credit for employing timber rings as a means for the accurate dating of prehistoric monuments goes to an American worker, Dr. A. E. Douglass, of the University of Arizona. By profession an astronomer, he first became interested in tree ring data in an effort to locate sun-spot cycles through the drought periods associated with them. Beginning as a casual enquiry into climatic influences, it developed into an appreciation of the valuable and accurate record which tree rings can add to local climatic history, and was then applied to the accurate dating of many of the prehistoric Pueblo ruins and cliff dwellings of the American South-West.

These relics of a past civilisation had long intrigued archæologists, but there was much doubt and argument over their actual age until tree ring dating changed speculation into hard fact. Some of these cliff dwellings were thought to be as old as 1000 B.C., but the earliest so far excavated has now been definitely dated 919 A.D., showing an error of almost 2000 years on the previous calculations based on other archæological matter. So accurate is this method of dating that the years of construction and occupation of individual houses have been worked out from the charred remains of roof timber and from unconsumed charcoal fuel. The Pueblo building activities are shown to have fallen off with each drought period until a great drought in the years 1276 to 1299, which was so severe that it completely destroyed most of their agricultural system of small inundation canals.

During a recent visit to America I had the privilege of studying Dr. Douglass' methods at Tucson, Arizona, and was much impressed by this example of scrupulous exactness in detailed research; so, a short account of the technique of his tree ring dating should be of some interest to scientific workers in various fields. Starting with the identification of individual year-rings in different trees from the same region, a calendar was gradually built up dating from living trees as far backwards into the past as contemporary trees or recently felled stumps would reach. It was found that the very arid and severe climatic conditions of the South-West were more or less common throughout eastern Arizona and western New Mexico, thus including the whole of a large zone of early Indian activity in the Colorado and Little Colorado basins, and extending further east into the Rio Grande basin. Throughout this vast area the main periods of drought have been a general experience, so that a characteristic pattern of the rings in any tree living in such a period becomes recognisable as a "signature".

Individual trees of course show minor inconsistencies, and in a completely canopied forest a sudden access of light to a crown by the death or removal of its neighbour trees will probably produce a wider ring than could be credited to any small increase in moisture. Actually most of the western yellow pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga taxifolia*) which have yielded the best data have grown in a very open forest type, for the country is so arid that it can best be described as an open dry savannah of scattered pine and juniper trees standing in open grass-lands, not unlike the dry *rakh* of the Punjab and Central India except that the tree species are mostly conifers instead of Leguminosæ. Just how far such data from moister and close-canopied forest types would be serviceable is doubtful, for Dr. Douglass' attempts to extend his tree ring chronology into the moister Californian forest types, with their temptingly long-lived species such as *Sequoia gigantea* and *sempervirens*, have not been so successful. The easier the growth conditions for the individual tree, the less it reacts in its growth to the hardship of individual years of drought, *i.e.*, it is "complacent" while the tree living in more trying conditions is more "sensitive " in its registration of drought years.

From present-day specimens the data can be carried back into the past by searching for timber from old dwellings, comparing their records, and linking them by "cross-dating" them to the ring patterns of known age. Gradually a series can be built up,

the outer rings of such old logs being matched with the oldest parts of modern trees. Small specimens can be cut from living trees with a simple boring instrument such as the Pressler's borer, which extracts a thin sliver of wood $\frac{1}{8}''$ thick and showing the rings upto $3''$ from the living bark. This, however, is not strong enough to sample the indurated wood of very old logs, and Dr. Douglass has used as a borer a steel tube $1''$ in diameter with saw teeth at the end, which extracts an $8''$ sample. Where a butt or stump is exposed, a triangular sample of the whole series of growth rings can be taken by making two slanting saw cuts across the face through the heart of the log, thus nicking out a piece on which every ring is exposed in cross-section.

In the actual analysis of rings, complications commonly met with are first, that small rings may be missed altogether, and second, that the double rings frequently caused by two wet seasons in one year may be mistaken for two annual rings. These can only be recognised after considerable practice, double or false rings having no sharp edge of ripened and flattened cell-walls such as characterise true autumn wood. This feature of false rings is a common source of inaccuracy in forest statistical work when doing ring counts to calculate the period of time required to grow trees of a given diameter, and even after considerable experience in wood anatomy one is liable to be misled. The only way to ensure accuracy, therefore, is to build up a chronological table of ring patterns from so many samples that the elusive microscopic ones and the locally common false ones are cancelled out over as wide a district as possible.

It was many years before a complete chronological table for Arizona could be built up, and in the interval the gradually accumulated data for the prehistoric timber from various excavated sites and derelict dwellings were built up into a "floating" table of relative dates. The position of this floating table in history could only be defined when sufficient links had been found to fill the gap beyond the oldest modern pine trees near Flagstaff, Arizona, which reached back to 1707. Many of these links were found in the roof beams from Hopi Indian dwellings, some of which are still in use with timber which has been felled several centuries ago. The last link connecting the floating table with this well-verified historical scale which stretched back to 1300 was finally provided by a buried and charred beam which was so fragile that it had to be well wrapped with twine before it could be lifted.

The coincidences between wood samples are more easily traced from small rings than from large ones, and the rings on each sample are charted on graph paper, giving an exaggerated upright line value for each small ring inversely proportional to its size (Fig. 1). A non-technical account of the work so far accomplished by Dr. Douglass and his helpers is given in "National Geographic Society Contributed Technical Papers; Pueblo Bonito Series, No. 1," Washington, 1935.

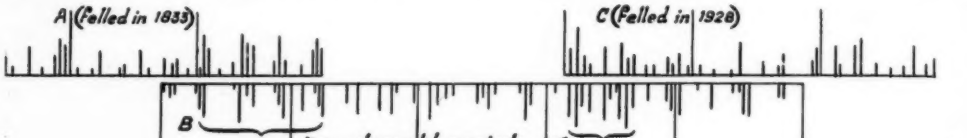


Fig. 1.
"Skeleton plots" showing small ring features of each timber specimen, and the process of matching characteristic groups of rings to build up a chronological table.

From a social aspect it is interesting to find that although the eclipse of the old Pueblo culture was in part due to a series of severe droughts, it was largely self-imposed through the wide-spread destruction of their upland pine forests by felling, burning, and heavy grazing. This was inevitably followed by excessive floods and droughts which rendered impossible their previous agricultural system of flood-water farming on the irrigable bottom lands along the outflows from these pine forest catchment areas. This corresponds roughly with what is happening to-day in many of the drier parts of the United States and the drier tropics of India and Africa, where the

natural vegetation has been destroyed by gross over-grazing and injudicious ploughing of natural grass-lands. In such places the contemporary local tree growth records will be found as a lengthening series of microscopic rings, just as in the period when the Pueblo culture was rapidly dying out. Dry spells may be inevitable, but their effects could largely be mitigated if we could, through a better knowledge of climatic cycles, foretell their arrival, and prepare for them through a more conservative use of the local resources of grass and timber. It is to be hoped, therefore, that some research may be taken up to show how far such data can be used to solve Indian problems in human and climatic history.

On the Structure and Function of the Ascidian Test.

By Dr. S. M. Das, D.Sc.,
Department of Zoology, Lucknow University.

THE present communication is intended primarily to supplement our knowledge of test of Tunicata, and secondarily to demonstrate that the test should not, as in the past, be regarded merely as an exoskeleton but should be considered as a medium for the communication of the animal with the outer world—comparable to the skin of the higher animals. The author's investigations were carried out on the test of the ascidian *Herdmania*, this animal being of a fairly large size and well represented in the coastal waters of South India.

The test of ascidians has been described by many authors in the past. Of recent years, Morgan[1] (1891) described the origin of the test cells; Herdman[2] (1899) gave a detailed account of the test in *Ascidia*; while Miss Herdman[3] (1924) worked out the histology of the test of *Botryllus*. None of these investigators, however, makes any mention of the presence of nerve-cells or of any nervous mechanism in the test. The author[4] has, however, demonstrated the presence of nerve-cells, nerve-fibres and receptor cells in the test of *Herdmania*.

The test, which except for the branchial and atrial apertures is the only part of the animal visible externally, surrounds the body of the ascidian and is about 4 to 6 mms. thick. At the postero-ventral end of the animal, however, the test is 2 to 3 cms. thick and constitutes a "foot" by which the animal remains attached to the sea-bottom. It is soft and leathery, more or less translucent and on sectioning cuts like soft cartilage. As in other ascidians it is composed of tunicine[5]—a close ally of cellulose. The general substance of the test consists of a clear matrix in which are present a large number of cells, interlacing fibrils, minute spicules and branching and anastomosing vascular tubes.

Test Vessels.—There are two main blood vessels, the *sub-endostylar test vessel* and the *sub-intestinal test vessel*, which enter the test and ramify into innumerable fine branches in its substance sending a few large branches into the "foot". These test vessels branch, anastomose and send fine branches towards the outer surface of the test where they end in ovoid or rounded terminal knobs or ampullæ (Fig. 1). The ampullæ appear red in colour due to the presence of red pigment in the ectodermal cells which cover them. These ampullæ appear very close to the outer surface of the test and thus bring blood into close contact with the oxygenated water in which the animal lives. They, therefore, form an apparatus for accessory respiration, which may be compared with the cutaneous respiration in other animals. The only other description of a respiratory organ besides the branchial sac (pharynx), in Tunicata, is that of Herdman[6] (1885).

The Spicules.—The spicules found in the test are of two types: the *microscleres*, which are very small in size, and the *megascleres*, which are much larger. They are all calcareous and have a definite shape

[1] Morgan, "Origin of test cells in ascidians", *Journ. Roy. Micr. Soc.*, 1891.

[2] Herdman, W. A., "L. M. B. C. Memoirs", I, *Ascidia*.

[3] Herdman, E. C., "L. M. B. C. Memoirs", XXVI, *Botryllus*.

[4] A detailed account of the investigations will be published elsewhere.

[5] Franchimont, "Sur la cellulose animale ou tunicine", *Compt. Rend. Acad. Sci.*, **89**, 755-56.

[6] Herdman, W. A., "On a new organ of respiration in the Tunicata", *Proc. Lit. Phil. Soc.*, 1885.

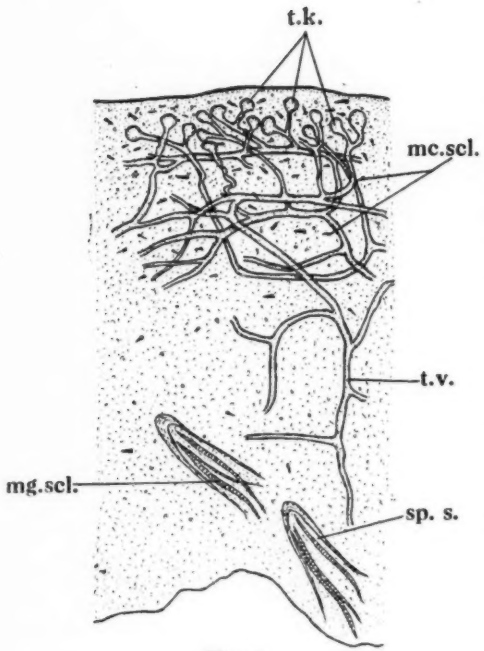


Fig. 1.

A vertical section of the test.—*mc. scl.*, microscleres; *mg. scl.*, megascleres; *sp. s.*, spicule sheath; *t.k.*, terminal knobs; *t.v.*, test vessel.

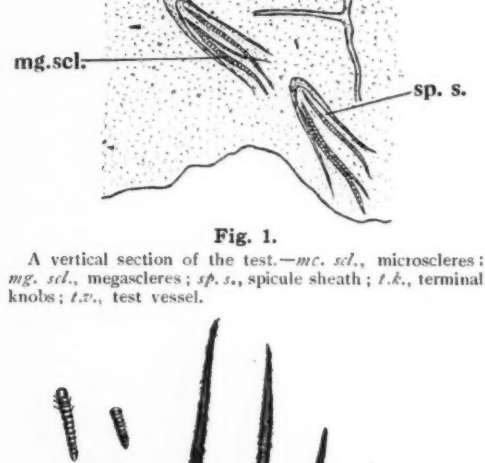


Fig. 2.

Spicules found in *Herdmania.*—*mc. scl.*, *mc. scl.* 1, microscleres; *mg.scl.*, megascleres; *p.s.sp.*, pipette-shaped spicules; *s.s.sp.*, spindle-shaped spicules.

(Fig. 2). The microscleres are found in large numbers scattered throughout the test substance. Each spicule consists of a knob-like head and an elongated body bearing spines arranged in rings. Two kinds of megascleres have been found: the *spindle-shaped* and the *pipette-shaped* spicules. The spindle-shaped ones are enclosed in a connective tissue sheath and are present mostly in the postero-ventral half of the test, where they form a covering round the larger vessels traversing the test. As in the case of microscleres, each spicule has a large number of rings of spines. The pipette-shaped spicules are larger than the spindle-shaped variety and differ from them in having a swelling in the middle. They are, however, never found in the test, being confined mainly to the mantle. Herdman[7] (1885) gave a description of calcareous spicules in Tunicata and later[8] (1891) founded the genus *Rhabdocynthia* (*Herdmania*) on the presence of spicules. But he seems to have missed the pipette-shaped spicules altogether and has also made no mention of the exact structure, arrangement and distribution of the spicules.

Test Cells.—The *cells* of the test are of many different kinds. Five different kinds of cells can be discerned in *Herdmania* (Fig. 3) besides the nerve-cells and receptor

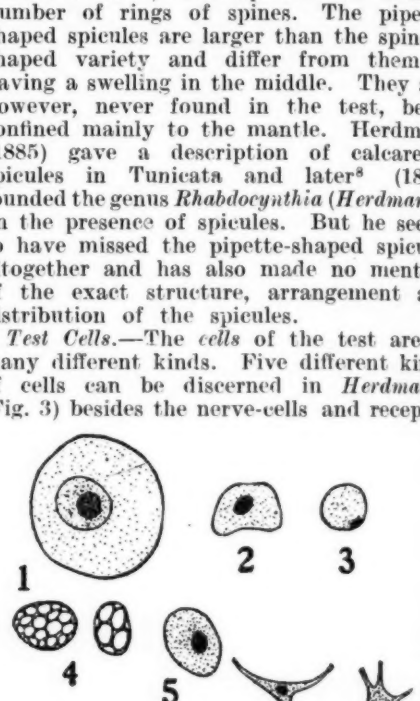


Fig. 3.

Cells found in the test.—1. Large eosinophilous cell; 2. Amœboid cell; 3. Small eosinophilous cell; 4. Vacuolated cells; 5. Granulated cell; 6. Nerve cell; *ep.*, epithelial cells from an ampulla.

cells described later. The largest of these are (1) the few *large eosinophilous cells*,

[7] Herdman, W. A., "The presence of calcareous spicules in the Tunicata", *Proc. Liv. Geol. Soc.*, **5**, 1885.

[8] Herdman, W. A., "A revised classification of the Tunicata", *Journ. Linn. Soc. Zool.*, **23**, 575.

usually spherical in shape and staining a bright red with eosin. The cytoplasm consists of a thin homogeneous mass of fine granules and the nucleus is a large vesicular structure in the centre of the cell. Next to these in size are (2) the *amœboid cells*, which are few and far between. The most abundantly represented cells, however, are (3) the *small eosinophilous cells* each with an excentric nucleus. They are scattered throughout the substance of the test but are more abundant in the inner half of the test than the outer. Further, there are (4) the *spherical vacuolated cells*, each of which may consist of three to four chambers or may contain a large number of small vacuoles. A nucleus cannot be seen in these cells. Lastly, near the outer surface of the test are (5) a few *granular cells*[9] with large nuclei, around which the nerve-fibrils of the test get specially concentrated. The large bladder-cells present in the test of *Ascidia*[10] and some other ascidians are not represented in *Herdmania*, unless the small spherical vacuolated cells are to be regarded as remnants of them.

Nerve-cells and Nerve-fibres.—When an ascidian is kept in a tank containing fresh sea-water and the stimulus of contact applied to various parts of the external surface (test), the animal is seen to respond to the stimulus in a definite manner. On touching the siphons with a hard body they are seen to contract, usually closing the branchial and atrial apertures in this way. The rest of the test, however, is not so sensitive as the siphons. Nevertheless, a sharp pin-prick on the test of the body proper also causes an immediate contraction of the part stimulated followed by a general contraction of the siphons and the body proper. The idea naturally followed that nervous tissue should be present in the test to enable the animal to feel the prick. Quite thin sections of the test, properly stained, revealed on examination a large number of cells in the test substance which resemble very much the nerve-cells of the higher animals.

Each nerve-cell (Fig. 3, 6) is pyriform, triangular or polygonal in shape, contains a large nucleus and gives out two to six dendrites which get very much elongated, join similar processes from other nerve-cells and form a network of nerve-fibrils in the matrix of the test. The nerve-fibrils thus serve to connect the various nerve-cells with one another. The nerve-cells are more numerous in the test of the siphons than in that of the body proper and more so in the outer part of the test than in the inner. This is as it should be, if we take into account the greater sensitivity of the siphons and the fact that stimuli always affect the outer part of the test first.

Receptor Cells.—The external surface of the test of *Herdmania* can be divided into (1) the vascular areas, which have numerous vascular ampullæ, and (2) the non-vascular areas which have no ampullæ. Sections through the vascular areas of the test, when properly stained, revealed the presence of fine nerve-fibrils leading distally into the polygonal ectodermal cells surrounding an ampulla, usually a single nerve-fibre terminating in each cell (Fig. 4). Proximally, these nerve-fibres run on for some distance towards the base of the ampulla and then join to form a thicker nerve-fibril that runs on in the matrix of the test and is continued into the processes arising from the nerve-cells. It is quite clear, therefore, that in the vascular areas of the test, the epithelial cells surrounding the ampullæ form centres for the reception of stimuli. The nerve-fibrils communicate

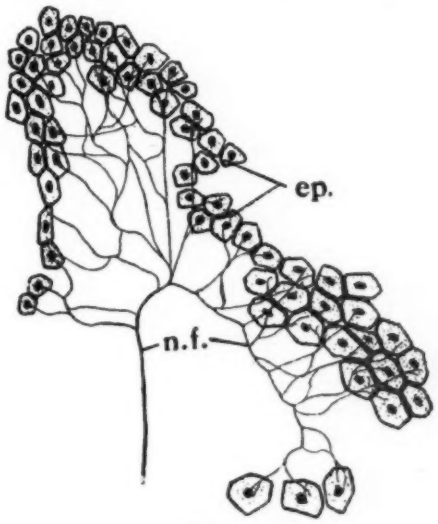


Fig. 4.

Nerve-fibres of an ampulla.—*ep.*, epithelial cells; *n.f.*, nerve-fibres.

[9] See account of receptor cells.

[10] Herdman, W. A., "L. M. B. C. Memoirs", I, *Ascidia*.

the stimuli to the nerve-cells. Experiments, however, showed that not only were the vascular areas of the test sensitive but that a pin-prick on the non-vascular areas of the test also produced similar effects though less marked in degree. Sections of the test through the non-vascular areas, revealed the presence of some ovoid cells, around which the nerve-fibrils of the test get specially concentrated. The presence of these cells in the non-vascular areas of the test, and their absence in the vascular areas, give additional proof that they have the same function here as that of the epithelial cells in the vascular areas.

Stimuli are, therefore, received by these receptor cells in the test and conducted by the nerve-fibrils which transmit them to the nerve-cells. Further, some nerve-fibrils from the nerve-cells pass into the mantle and finally join the nerves leading into the nerve-ganglion or brain. The instantaneous reaction to stimuli clearly shows that the nervous mechanism of the ascidian—though the nerve ganglion is said to be the degenerate representative of the larval brain and nerve-cord—is really very well developed.

Growth and Organisation of the Test.—The test in a living ascidian is continually worn at the surface. Growth takes place by the formation of tunicine by the ectodermal cells lining the inner surface of the test and also by the mesodermal cells which migrate into the test through the walls of the test vessels and the vascular ampullæ.[11] The new test always gets organised by the immigration of the various kinds of cells into it. The test as a whole, therefore, not only serves for the protection and attachment of the animal (facts mentioned in most text-books of Zoology) but also acts as a respiratory and a receptor organ.

Mention must be made here of the fact that this is the first time in the history of our knowledge of the Tunicata that a definite nervous mechanism has been demonstrated in the test or outer covering of these animals. The author wishes to express his thanks to Dr. Sundara Raj of the Madras Fisheries Department for placing the resources of the Tuticorin Fisheries Station at his disposal for the collection of material. Acknowledgments are also due to Prof. N. J. Berrill of Montreal and Prof. E. S. Goodrich of Oxford for their kind suggestions. To Prof. K. N. Bahl of Lucknow he is very much indebted for taking keen interest in the progress of the work.

[11] Herdman, W. A., "L. M. B. C. Memoirs," I, *Ascidia.*

Theoretical Biology.

TO promote the study and work in the field of Theoretical Biology, a foundation for Theoretical Biology of animal and man, has been founded at the University of Leiden. In memory of the late Professor of Zoology, Van der Hoeven (1801–1888), the author of the "Philosophia Zoologica," it is called "Professor Dr. Jean van der Hoeven Stichting von theoretische biologie van dier en mensch". The chief objects of the foundation are (1) to arrange for lectures at the University of Leiden, (2) to bring to Leiden, biologists who are interested in theoretical biology into contact with their colleagues in Holland and abroad, to bring about a contact for scientific purposes and organisations between theoretical biologists all over the world, for instance, by arranging international symposia on theoretical biology, (3) to publish articles on theoretical biology, and (4) to found a library on this subject. Directors of the foundation are Dr. C. J. van der Klaauw, Professor of General Zoology and Dr. T. A. T. Barges, Professor of Medical Anatomy, both at Leiden, and Dr. Adolf Meyer, Professor of Theoretical Biology at Hamburg.

Obituary.

Dr. Paul Brühl (1855—1935).

PROF. PAUL JOHANNES BRÜHL was born in Saxony on the 25th February 1855 and was the only surviving son of Michæl Brühl. He finished his early education in German schools and colleges and joined the botanical touring party obtaining the travelling scholarship, as was customary during those days. He walked all the way through Central Europe, Asia Minor and Armenia after halting for a short period at Constantinople where he worked as a teacher for some time. During his tour he made valuable botanical collections. He reached India in 1881 and joined the Rajshahi College in 1882 as a teacher of Natural Sciences. In 1883 he married Annie Betts Fox. His botanical interest was known at this time and the reputed Botanist Sir George King, the then Superintendent, Royal Botanic Garden, Calcutta, got him transferred to the Bengal Engineering College in 1887. Here Prof. Brühl taught various subjects such as Chemistry, Physics, Geology including Mineralogy, Heat Engines and Agriculture. His vast knowledge in many subjects and more than fourteen languages and art of teaching and laboratory methods were of a high standard which soon gained explicity all over this country. His popularity and sympathy towards his students and his keen interest in their welfare made Prof. Brühl's name a household word in many a Bengali house. His research work in Botany during his off time after the teaching work at the Engineering College found expression in such voluminous publications as *A Century of New and Rare Indian Plants* in collaboration with Sir George King. This work was published in the *Annals of the Royal Botanic Garden, Calcutta*, Vol. V, part II with 102–200 plates, most of which are Brühl's own sketches. His papers on "Plant Immigrants" is an important contribution towards the distribution of foreign plants in India. He officiated as the Principal of the Engineering College for some time. He retired from the Engineering College in 1912 and in recognition of his valuable and faithful service for forty years in the Government Educational Department, the title of Indian Service Order was conferred upon him by the Government of Bengal. After his retirement from the Government service his interest for research work did not abate. In 1912 from October to March, he worked in Chemical Geology in the Indian Institute of Science, Bangalore. He was for some time teacher in Geology and Mineralogy at the Presidency College, Calcutta, and officiating Patent Secretary to the Government of India. At the request of the late Sir Ashutosh Mukerjee, he accepted the post of the Registrar, Calcutta University, in 1913, and worked as a Registrar, Controller of Examinations and Secretary of the Arts and Science Department of the post-graduate classes which was just developing at this time. He had also to offer his valuable suggestions in building up the Post-Graduate Laboratories and was subsequently entrusted to build up the Biological Laboratory of the Calcutta University and was appointed the University Professor of Botany. His scientific investigation was recognised by the University in offering him Doctor of Sciences as *Honoris Causa*. As a University Professor he is one of the pioneers in the investigations of the Lower Cryptogams and in forming the present Indian Botanical Society of India. Here, as a teacher of the post-graduate classes in Botany again, he was able to contribute a large number of papers in Botany—his much beloved subject—in collaboration with his students. As president of a Committee appointed by the Government of Bengal, his research work, financed by the Government of Bengal, on the eradication of Water Hyacinth from 1925 onwards resulted in the publication of many papers which suggested various avenues of investigation on this vital question.

Among his many publications his latest contribution entitled "A Census of Indian Mosses" published in the *Records of the Botanical Survey of India*, Vol. VIII, 1930, and his book on "Sikkim Orchids" are of the greatest value to the botanical investigation in India.

He has left one son and three daughters and many successful students, friends, colleagues and admirers to mourn his loss.

K. BISWAS.

Letters to the Editor.

The Nature of the Transition from Troposphere to Stratosphere and Upper Air Temperatures over India in the Winter and Hot Seasons.

USUALLY in the tropics, the decrease of temperature with height which characterises the lower atmosphere, ceases suddenly at a height of 16–18 gkm. and a rise of temperature with height commences. In the winter and early hot season in N. India, below the above-mentioned inversion, there is often found another inversion or isothermal layer or layer of very small positive lapse-rate which may be more than 2 or 3 km. thick. Examples of such layers are shown in Fig. 1. The lower limit of this region may sometimes be as low as 10 gkm. in N. India. Dr. K. R. Ramanathan and Mr. K. P. Ramakrishnan in their paper on " Sounding Balloon Ascents at Poona and Hyderabad " explained this type of structure as being due to a meridional movement of air near the tropopause, the upper transition corresponding to the usual tropopause of tropical latitudes and the lower one to that of temperate latitudes. With a view to analyse the conditions of

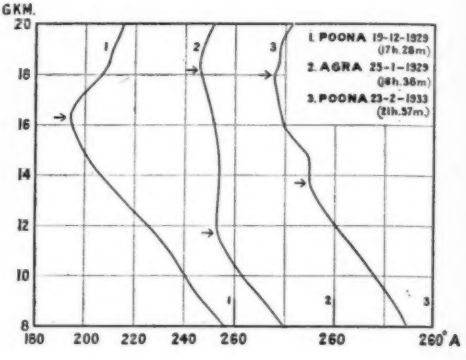


Fig. 1.

upper air temperature associated with this composite type of tropopause, the available sounding balloon data at Agra during the

TABLE I.

Number of occasions when the deviations of temperature from the mean of the month was between prescribed limits (Agra, 1925–1931).

A. When there was a first transition from troposphere to stratosphere at 10–12 gkm.
B. " " " " at 12–14 gkm.
C. When there was no sudden decrease of lapse-rate below 14 gkm.

ΔT °C / H gkm.	A						B						C					
	<−4	−4 to −2	−2 to 0	0 to 2	2 to 4	>4	<−4	−4 to −2	−2 to 0	0 to 2	2 to 4	>4	<−4	−4 to −2	−2 to 0	0 to 2	2 to 4	>4
Ground	3	2	6	5	3	3	2	3	4	3	3	1	8	5	8	7	10	8
2	1	3	4	9	1	3	1	3	3	2	4	2	4	4	13	11	11	3
4	2	2	13	1	3	0	0	1	3	4	5	3	3	4	11	11	13	5
6	5	4	7	4	1	0	0	2	1	3	5	4	3	4	11	12	10	7
8	7	4	8	2	0	0	0	1	4	1	5	4	5	5	7	7	15	5
10	14	4	3	0	0	0	1	2	3	4	4	1	6	2	7	9	7	14
12	6	3	4	3	4	2	8	3	2	0	2	0	5	6	9	10	5	12
14	0	1	4	5	6	6	2	3	2	3	2	3	11	4	9	12	8	3
16	1	2	1	3	4	7	1	2	3	3	4	2	11	6	8	8	5	6
18	0	1	2	4	4	7	2	2	1	2	2	2	10	7	5	6	4	5
20	0	1	1	1	3	3	2	0	0	0	1	1	6	3	4	6	2	4

period November-March 1925–31 were arranged into three groups: (1) when a lower transition was present between 10 and 12 gkm., (2) when it was present between 12 and 14 gkm., and (3) when there was no evidence of such a transition below 14 gkm. Fig. 2 shows the average temperatures at different levels corresponding to each of

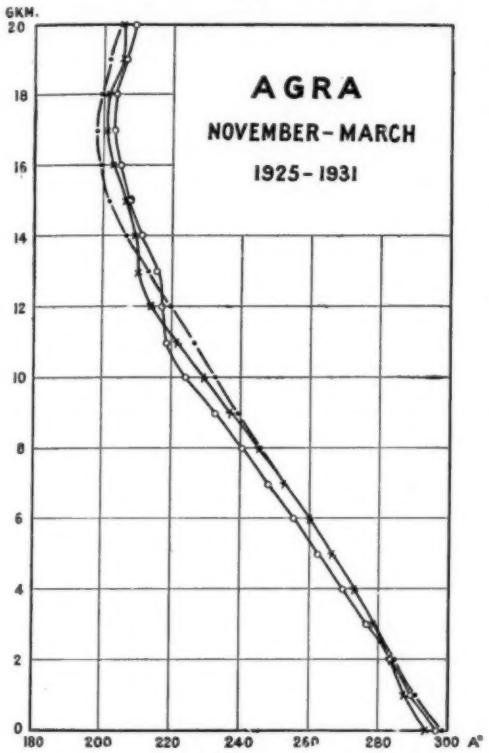


Fig. 2.

Mean Height Temperature Curves on days when a large decrease of lapse rate occurred.

(1) Between 10 & 12 gkm. O—O
(2) ,, 12 & 14 gkm. ×—×
(3) Above 14 gkm. ●—●

these three groups. It is clear from the figure that on the average, the presence of a lower transition is associated with abnormally cold air between 4 and 12 gkm. and abnormally warm air above 13 gkm. The occurrence of the tropical type of tropopause in this season goes on the average with higher temperatures upto 12 gkm. and lower temperatures above.

The frequency table (Table I) given above shows that while the presence of a lower transition is generally associated with abnormally low temperatures for 3–6 gkm. below that level, the converse proposition that extra low temperatures at say 8 to 12 gkm. are generally accompanied by a lower transition immediately above, is less certain.

As the upper inversion at 16–18 gkm. is present in more or less pronounced form on all occasions, we have to consider that it is due to some permanent cause—probably the presence of ozone. When meridional advection brings up air of lower latitudes to north India at these levels, the upper inversion may be expected to be more pronounced and conversely, when air from higher latitudes is brought over, the inversion will be less pronounced. Over Poona, the composite type of tropopause is less common, and when it occurs is less well-marked than

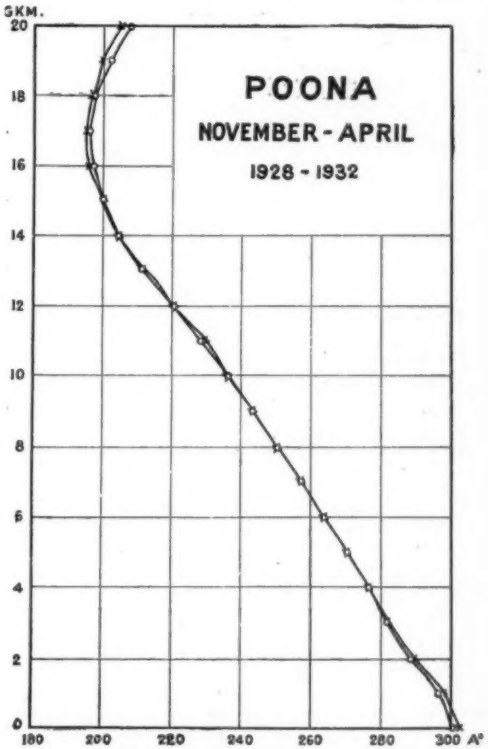


Fig. 3.

Mean Height Temperature Curves on days when a sudden decrease of lapse rate occurred.

(1) Between 13 & 15 gkm. O—O
(2) Above 15 gkm. ×—×

over Agra. It was therefore considered sufficient to analyse the Poona data into two groups: (1) when there was evidence of a lower transition between 13 and 15 gkm. and (2) when there was only one transition above 15 gkm.

Fig. 3 gives the average temperatures at different levels over Poona corresponding to each of these two groups. The difference between the two sets of averages is insignificant. Meridional advection can be expected to show the characteristic double transition best in those latitudes where the rate of change of height of tropopause with latitude is large. Agra lies in such a region in winter while Poona does not.

I am thankful to Dr. K. R. Ramanathan for suggesting this analysis.

Poona, M. W. CHIPLONKAR.
September 27, 1935.

Further Observations on the Diamagnetism of the Trivalent Bismuth Ion.

IN our note on the subject,[1] the value (43·80) for the diamagnetism of the trivalent bismuth ion was obtained by modifying the original Slater formula by assigning for electrons in the lower groups instead of shells and the *d* and *f* groups a value 0·85 instead of the usual 1. We have now calculated the value for Bi^{+3} by the orthodox Slater formula and its modification proposed by Angus and obtain the following results :—

$-x\times10^6$		Experimental	Slater	Angus
	Bi^{+3}	41·24	42·23	42·09

The agreement is as good as can be expected particularly on the Angus formula. More so when one realises that the Slater method is strictly valid for ions of the closed configuration type. Kido has brought out an interesting empirical relationship which seems to hold for a number of ions according to which the difference in the susceptibilities of ions due to two electrons is of the following order :—

	$-\Delta x\times10^6$
$P^{+3}-P^{+5}$	= 9·4
$As^{+3}-As^{+5}$	= 8·2
$S^{+4}-S^{+6}$	=10·4
$Se^{+4}-Se^{+6}$	= 9·5
$Cl^{+5}-Cl^{+7}$	=11·1
$I^{+5}-I^{+7}$	=12·5

The value for Bi^{+5} for which the Slater and Angus formulæ should strictly apply, has been calculated to be 29·22. The difference between Bi^{+5} and Bi^{+3} calculated on the Angus formula is 42·09−29·22= 12·87, which is of the same order as suggested by Kido and is of particular significance.

It may be recalled here that out of the many compounds of bismuth mentioned in our last note, the susceptibility values of four are described in the *International Critical Tables* (Bi_2O_3, $BiCl_3$, $BiBr_3$, BiI_3). Three of these are in excellent accord with our values and only one has been shown to have a lower value.

Full results are being communicated to the *Journal of the Indian Chemical Society*.

S. S. BHATNAGAR.
BHIM SAIN BAHL.
University Chemical Laboratories,
Lahore.
October 5, 1935.

[1] *Curr. Sci.*, 1935, **4**, 153.

Some Aspects of the Mechanism of Non-Symbiotic Fixation of Atmospheric Nitrogen.

PREVIOUS studies on the economy of carbon during fixation of atmospheric nitrogen by Azotobacter, particularly by Stoklasa[1] and by Ranganathan and Norris[2] would suggest that the nitrogen fixers derive their organic nutrition chiefly from carbohydrates, though small quantities may be fixed in presence of other organic substances as well.

Our studies with the mixed flora of the soil showed that glucose which was provided as the organic nutrient was completely decomposed in the course of the first four days, being mostly converted into gases. Of the residual organic matter, 44·1 per cent. was accounted by micro-organisms (living as well as dead), 34·0 per cent. by organic acids (chiefly lactic, acetic, propionic and butyric) and the rest in some (yet unidentified) water soluble form. During this period only about a third of the usual quantity of nitrogen was fixed, and of this, the major part was present in water soluble form. In the course of the next four days a large part of the organic acids was lost, accompanied by corresponding increase in mucilage. There was also rapid fixation of atmospheric nitrogen, the C-N ratio of the organisms changing from 62·1 to 20·6. Between the 8th and the 12th days, there was very little change in the other constituents, but there was further fixation of nitrogen. After the 12th day, there was

slight loss of organic carbon, but there was no appreciable fixation of nitrogen.

TABLE I.

Distribution of Organic Carbon.

Time in days	Carbon in mg. (as present in 50 c.c. of medium)				
	Total organic carbon	Sugar	Organic acids (so far identified)	Microbial tissue	Unidentified
0	173·7	170·4	Nil	Nil	Nil
2	111·7	83·6	13·2	13·6	Nil
4	55·0	Nil	19·8	24·2	7·7
8	53·4	Nil	5·8	39·8	4·5
12	55·5(?)	Nil	4·8	39·9	7·5(?)
16	50·5	Nil	..	39·4	..

Carbonate carbon (including dissolved CO_2) was estimated at each stage, but has not been included. The soil used for inoculation contained 3.3 mg. of carbon.

TABLE II.

Nitrogen Fixed and C-N Ratio.

Time in days	Nitrogen fixed in milligrams in 50 c.c. medium		C/N	
	Total	In bacterial tissue	In the whole medium	In bacterial tissue
0	Nil	Nil	..	..
2	0·78	0·39	143·2	43·9
4	1·26	0·39	43·7	62·1
8	2·42	1·93	22·1	20·6
12	3·07	2·90	18·0	13·8
16	3·15	2·95	16·0	13·4

TABLE III.

Distribution of Organic Acids (so far identified).

Time in days	Organic acids in mg. of carbon (in 50 c.c. medium)					Total acids
	Non-volatile	Volatile				
	Lactic	Acetic	Propionic	Butyric	Total	
2	6·1	2·7	0·6	3·8	7·1	13·2
4	12·8	3·1	0·4	3·5	7·0	19·8
8	Nil	..	..	..	..	5·8
12	Nil	..	..	..	..	4·8

It would be seen from the above that (*a*) the carbohydrate contributes only partly to the fixation; (*b*) organic acids are mostly utilised for the growth of the organisms and fixation of nitrogen; and (*c*) the production of mucilage and nitrogen fixation, though related, are not directly proportional to each other.

That the immediate products of decomposition of sugar are utilised in the fixation is further proved by the following results (Table IV):—

TABLE IV.

Time in days	Nitrogen fixed in mg. (in 50 c.c. of medium)	
	Residue sterilised and freshly inoculated	Unsterilised (control)
4	0·25	2·10
8	1·62	2·62

Further work is in progress to determine (*a*) the manner in which organic acids or their calcium salts assist in fixation, and (*b*) the nature of the water-soluble nitrogen formed in the early stages and its relation to the subsequent fixation. The studies are also being extended to pure strains of nitrogen fixers.

T. R. BHASKARAN.
V. SUBRAHMANYAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
September 17, 1935.

[1] Stoklasa, *Zentralbl. Bakt. II*, 1908, **21**, 408.

[2] Ranganathan and Norris, *J. Indian Inst. Sci.*, 1927, **10A**, 79.

The Occurrence of Azotobacter at High Temperatures.

A GOOD deal of controversy has been going on for some time past, with regard to the action of light in tropical soils on such important soil phenomena as Nitrification, Nitrogen fixation, etc. Since Azotobacter and other Nitrogen-fixing organisms flourish the most between 25°C. and 30°C. and undergo encystment at higher temperatures, it is assumed by some investigators that when soil temperatures are higher than 30°C. in summer, no physiological activity can be expected from the Nitrogen-fixing organisms. It would perhaps be

worth while to test the correctness of the assumption by actual examination of the soils which have attained higher temperatures in summer for the presence of Azotobacter and other Nitrogen-fixing organisms. We have endeavoured to find information on this point by examining a few soil samples taken in June last when typical summer conditions were prevailing.

The following table would show the atmospheric temperature, soil temperatures and moisture contents of the soils:—

Soil Used	Atmospheric Temperature. °C.	Soil Temperature °C.	Moisture Contents %
1. Cultivated soil with low Moisture Content ..	49	44	8·6
2. Cultivated soil with high Moisture Content ..	,,	42	21·1
3. Garden Soil	,,	42·5	19·5
4. Grass Soil	,,	45	0·36

Samples of soils mentioned above were divided into two portions of equal weights, one lot of each soil was heated upto 80° C. for ten minutes so as to kill all the vegetative forms, and the other lots were left unheated.

A small quantity from each of these eight soil samples, *viz.*, four heated ones and other four un-heated ones, were inoculated in the liquid Ashby's mannite medium. After a few days' incubation at room temperature the pellicle was observed in all the unheated soils, while no pellicle could be seen in the heated samples. Dilutions were also made from each flask and each dilution after addition to Ashby's mannite Agar was plated out in sterilized Petri dishes. In a few days' time the Azotobacter colonies appeared along with some other bacteria in the plates of the unheated soils. In the plates of heated soils, however, other types of bacteria appeared while Azotobacter colonies were very few or none at all in number. Pure cultures were made from Azotobacter and other bacterial colonies appearing on the plates and are kept for further work.

It is not possible at this stage to write definitely regarding the species of Azotobacter which have been observed at such high temperatures in all the samples stated above, but the view held by some investigators that photo-fixation of Nitrogen is the only process of Nitrogen-fixation prevailing at temperatures higher than 30° C. can no longer be maintained, because it has been amply proved that Azotobacter cells are present in the vegetative state in the soil at temperatures as high as 45° C.

This is probably an instance of the frequently observed phenomenon of the adaptation of living organisms to their environments.

JAGJIWAN SINGH.
AHMAD HUSSAIN.

Botany Department,
Government College, Lahore.
August 14, 1935.

Pungency in Chillies (*Capsicum annum*) A Mendelian Character.

CHILLIES (Red pepper) is one of the important agricultural crops of South India and it is grown mainly for the pungent fruit which is an indispensable item in the dietary of Indians. There are ever so many varieties differing in size, shape, colour and pungency of the fruits. While the varieties grown as field crops are all highly pungent, those grown on a smaller scale and used mainly as a vegetable are not so. The pungent varieties are generally small fruited and contain a large amount of seed while the non-pungent ones are big fruited, more fleshy and contain less of seed. Evidently the evolution of the big-fruited varieties has taken place with the loss of pungency. The variety (*Capsicum frutescens*) which still grows wild in several parts of the Presidency has extremely small fruits and is the most pungent of the group.

The inheritance of a large number of characters in chillies has been studied by Deshpande[1] (1933) but we have not come across any reference to the inheritance of pungency. It has therefore been considered that the information given below with regard to this character will be of interest.

We have been growing recently a large number of chilly varieties at the Paddy Breeding Station, Coimbatore and we have also made some crosses amongst them. One of these crosses was between a variety 'Elephants-trunk'—a long big fruit without any pungency and another small-fruited variety but extremely pungent. The F_1 was found to be pungent and a portion of the F_2 has been raised recently. Due to the unfavourable season, several of the plants had

succumbed to wilt and thrips after transplanting, leaving only 25, which matured and bore fruits. The fruits of these plants were examined individually and it was found that 18 bore pungent fruits while 7 were definitely non-pungent. The non-pungent fruits were easily distinguishable from the pungent though there was a good bit of variation in the latter.

The active principle in chillies which accounts for the pungency is an organic compound with a definite constitution and it is possible, its presence or absence may be tested chemically, but so far as our examination recorded here is concerned, we classified the plants by actually tasting the fruits of each plant. Some more of these F_2's have since been grown and in addition to pungency, other characters like size and shape and the amount of seed present and their association with the pungency character are under study. The results will be published separately.

K. RAMIAH.
M. RAYAPPA PILLAI.
Agricultural Research Institute,
Coimbatore,
October, 1935.

[1] Deshpande, *The Ind. Jour. Agri. Sci*, 1933, **3**, 219-300.

Basal Branching in the Earheads of the Pearl Millet—*Pennisetum typhoides*, Stapf and Hubbard.

THE inflorescence of the Pearl (Spiked) Millet is its characteristic rod-like false spike. Round a central axis are clustered together a number of fascicles having short pedicelled flowers. The hermaphrodite and antheriferous flowers together with the bristle brush constitute the fascicle. This rod-like disposition eminently meets the necessities for the fertilisation of this protogynous, lodiculeless millet with its delicate stigmas.

As recorded by Bews,[1] starting from the spreading type of panicle the main evolutionary trend in grasses has been "towards contraction, condensation, reduction and as a result increased protection". The protogyny and absence of lodicules impose additional needs for this protection in this millet.

Stapf in his description of the Pennisetums of Tropical Africa[2] mentions the occasional occurrence in some specimens from Nigeria of an abnormality in which "many of the lower and intermediate fascicles are replaced by slender spike-like branches up to 8 inches long". Such an abnormality has been experienced at Coimbatore in the case of an odd plant from a variety of the Bellary district.

In the year 1934 in some Sorghum seed imported from Nigeria, there was an odd seed of pearl millet which gave rise to an earhead whose unusual length attracted attention. The basal portion of this earhead was normal and unbranched. The

seeds from this odd plant were sown and a crop raised. In this population a clear segregation between entire and branched bases was noticed. Counts were taken and gave 342 unbranched and 127 branched bases (*vide* illustration). The segregation was sharp.

The branching occurred over an area of two inches at the base. An analysis of this area together with a corresponding two inches of the normal unbranched area gave the following figures:—

	Unbranched area	Branched area
Number of branches ..	..	28
,, fascicles ..	142	1,446
,, grains	437	1,431
,, grains in a 2 gm. weight ..	135	263
Weight of grains (gm.) ..	6·39	10·95
,, chaff (gm.) ..	·96	2·95

The above table clearly reveals the economic disabilities of this branched atavistic condition which has proved a simple recessive to the normal rod-like inflorescence of this millet.

G. N. RANGASWAMI AYYANGAR.
P. V. HARIHARAN.
S. R. RAMAKRISHNAN.

Millets Breeding Station,
Coimbatore.
October 1, 1935.

[1] *The World's Grasses*, 1929, p. 18.
[2] *Fl. Trop. Afr.*, 9-6, p. 1046.

Peucedanum graveolens—A New Host of Powdery Mildews.

DURING the last winter season a local variety of *Peucedanum graveolens* commonly known as soâ—a herbaceous plant used in curries and cultivated for its seeds and leaves—was found to be attacked by powdery mildews. Subsequent observations indicated that the first sign of the disease is found in the appearance of small white specks on the lower filiform leaves. The infected spots enlarge, coalesce and gradually cover the entire assimilating surface. With advance in season, the fungus spreads from leaves to the stem and finally infects the inflorescence. In severe cases the attack is damaging and the seeds fail to mature properly.

The usual organism appears to be similar to what has been described by Uppal and Desai on *Cuminum Cyminum*.[1]

Detailed investigation is, however, in progress and will be reported subsequently.

B. N. SINGH.
S. C. CHAKRAVARTI.

Institute of Agricultural Research,
Benares Hindu University,
September 28, 1935.

[1] "Cumin Powdery Mildew", *Dept. of Agriculture*, Bombay, *Bull.* No. 169, 1932.

The Method of Selecting a Representative Sample in Social Research.

By P. V. Sukhatme,
*Department of Applied Statistics, University College, London, W.C.*1.

IN Social Research, it is often required to estimate the average value of a character of some individuals. Such averages may be calculated whenever possible from the data supplied by the decennial census in India. These data do not, however, always provide the necessary material required for all types of population research and it is, therefore, imperative that fresh inquiries should be undertaken from time to time to collect the material.

It is, however, obvious that an *exhaustive* inquiry cannot be undertaken every time for want of both time and money. Nor is it necessary for the attainment of sufficiently accurate results. It is therefore advisable to base the results on the data supplied by the process of sampling. This process has been termed the 'Representative Method'.

It has been shown by Dr. J. Neyman that the most general aspect of the representative method is that of random stratified sampling of groups.[1] The method consists in dividing the population studied into parts called 'strata' and in sampling randomly from separate strata. The number of sampling elements to be chosen from each stratum may be determined by any one of the following methods:—

(1) The method of proportional sampling suggested by Professor A. L. Bowley.[2]

[1] J. Neyman, *Jour. Roy. Stat. Soc.*, **97.**
[2] A. L. Bowley, *Bull. Int. Stat. Inst.*, **22.**

(2) The method suggested by Dr. J. Neyman.[1]

The first method consists in choosing a number of elements from each stratum proportional to the total number of elements M_i in that stratum. The second consists in choosing a number from each stratum proportional to the product $M_i \sigma_i$ for that stratum. (σ_i^2 denotes the variance of the elements of the ith stratum about the mean of that stratum.) If σ_i^2 has different values in different strata, as is invariably the case, the second method is known to be more accurate than the first.

In general we do not know the values of σ_i. They can, however, always be estimated by means of a preliminary inquiry. It has been shown that if the σ_i's are estimated from sufficiently large samples (each of the order of 20 elements), then Dr. Neyman's method will almost invariably lead to more accurate results. Further it has been found that if the variability of the character sought within the single strata is very different in different strata, the gain in accuracy is of considerable magnitude.

The question of expense connected with the preliminary inquiry has also been considered and it has been found that in most cases Dr. Neyman's method is still advisable and may not prove too expensive.

The details will be found in the forthcoming issue of the Supplement to the *Journal of the Royal Statistical Society*, London.

Occurrence of Lime in Edible Momordica.

By H. L. Chakravarty, M.Sc.,

Herbarium, Royal Botanic Garden, Calcutta.

ABUNDANT deposit of lime in the form of crystals or cystoliths have been observed in the body cells of our common "Uchhya or Corola" (*Momordica charantia* Linn.) and Kakrol (*Momordica cochinchinensis* Spreng). Lime as calcium carbonate occurs in the form of cystoliths in leaves and as calcium oxalate it occurs as crystals mostly in stems and petioles. Portions of the cuticular membrane of the under-surface of the leaves of the two species when seen under the high power of a microscope, groups of globular deposit of calcium carbonate over a cellulose skeleton are visible. Such an aggregation of globular deposit of lime is defined as cystolith. These cystoliths are frequently present in the lower epidermal cells of the leaves and due to deposits of large quantities of calcium carbonate the epidermal cells grow considerably in size. Sometimes they are as large as ten times that of the size of an ordinary epidermal cell. These inflated cells containing cystoliths are gradually pushed into a considerable depth of the mesophyllous tissue and hence in a transverse section they seem to arise from the spongy tissue of the mesophyll.

The presence of the cystoliths of *Momordica charantia* was first observed by an Italian scientist, Dr. Otto Penzig,[1] in 1881. He determined also the nature of the structures of the cystoliths. Zimmermann[2] in his recent monograph on Cucurbitaceæ has described a few European and African Momordica. It appears that no contributions have yet been made towards the anatomical nature of the leaf-cells containing cystoliths of Indian species of Momordica. I have therefore made an attempt towards this direction. A group of cystoliths is the separate deposit of lime in various fantastic aggregations on a central skeleton. Cystoliths generally occur in groups of 2–7. In Fig. 1(A), Plate I, we find a cystolith of triple group as is found in *M. charantia*. In this species cystoliths occur also in groups of 2–4. Sometimes cystoliths are present in as many groups as seven (see Fig. 2(A), Plate I). Such groups of seven are seldom met with. In the process of the growth of cystolith calcium carbonate is strongly impregnated over a cellulose skeleton and when the deposit of calcium carbonate is dissolved in dilute HCl a skeleton of cellulose with concentric stratification makes its appearance. The cystoliths of *M. charantia* are more or less of definite regular oval-shaped structures and are non-branched and monoplanous.

The cystolith of *M. cochinchinensis* appears to have not yet been reported by any previous worker (see Figs. 3, 4). They are mostly irregular in structure, branched and

[1] Penzig, *Verbreit d. cystolith etc.*, *Bot. zentralbl*, **1881**, **8**, 393-403 and Tables II-IV.

[2] Zimmermann, *Die. Cucurbitaceen*, Jena Verlag Gustav, Fischer, 1922.

heteroplanous. In the beginning of the formation of cystoliths in this species the cystoliths do not show much difference from those of *M. charantia* but as they grow up they branch off and ultimately show the characteristic structure as shown in the figure. Here also as in the previous species,

(*Continued on p.* 261.)

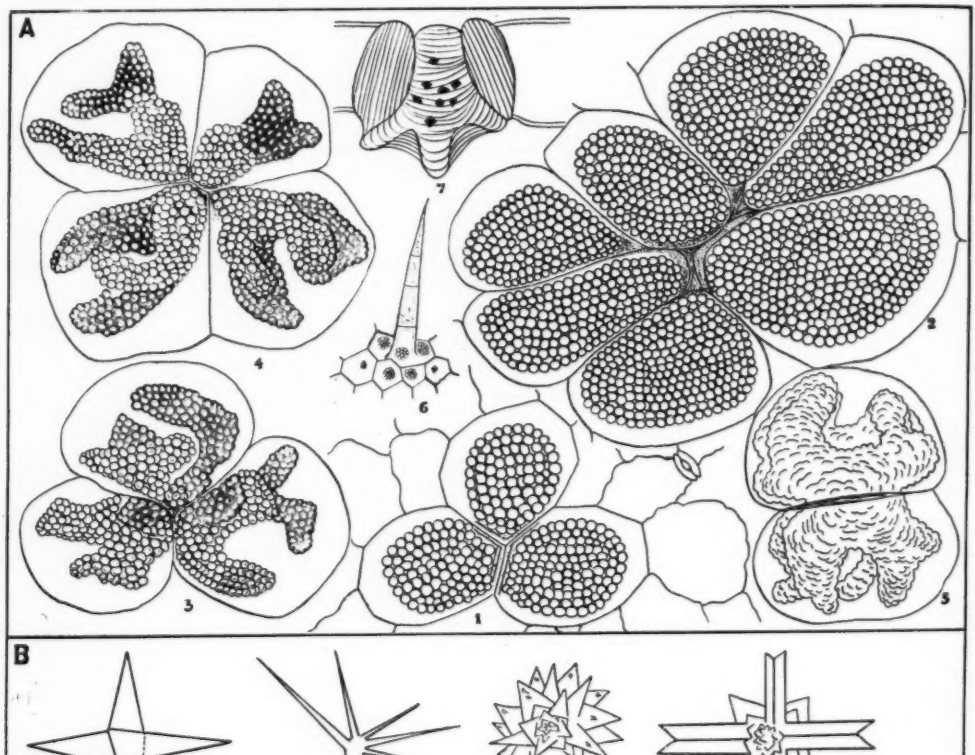


PLATE I.

SUPPLEMENT TO "CURRENT SCIENCE".

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Norwich, 1935.

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS.

Mathematical and Physical Sciences.

President: DR. F. W. ASTON, SC.D., D.SC., LL.D., F.I.C., F.R.S.

THE STORY OF ISOTOPES.

A HISTORIC account of Isotopes has to begin with Prout's speculative suggestion that all atoms are made up of the particles of some primordial substance. It follows as the result of this hypothesis that the atomic weight of an element must be expressed in whole numbers. It was soon found by chemists that this was not the case and the hypothesis was thus abandoned.

The next landmark in the progress of the idea of Isotopes is to be found in the remarkable statement of Crookes in his Presidential Address, Section B, at Birmingham in 1886, "I conceive, therefore," he said, "that when we say the atomic weight of, for instance, calcium is 40, we really express the fact that, while the majority of calcium atoms have an actual atomic weight of 40, there are not a few which are represented by 39 or 41, a less number by 38 or 42, and so on". These hypothetical components, he called 'meta-elements', but this suggestion of Crookes did not bear any fruit.

The discovery of radio-active phenomena in which the attention of the experimentalist is focussed on the behaviour of individual atoms, led the way to the discovery of elements with identical chemical properties but different atomic weights. The first definite indication of the existence of such elements is to be traced to the discovery by Boltwood in 1906 that ionium and thorium, when mixed together, could by no known chemical process be separated from each other. The radio-active law that when a radio-active element loses an α-particle, it goes back two places in the periodic table and by the loss of a β-particle, it goes forward by one place, may be taken as the first definite formulation of the nature of Isotopes.

Soddy was the first to call two elements having identical chemical properties and difficult of separation when mixed, Isotopes or Isotopic elements, because they occupy the same place in the periodic table. Uranium lead which results from uranium of atomic weight 238 by the loss of eight α-particles has an atomic weight of 206 and thorium lead which results from a loss of six α-particles from a thorium atom has an atomic weight of 208. Soddy put forward the view that the atomic weight of the lead found in uranium minerals must be less and that of the lead found in thorium minerals, more than the atomic weight of ordinary lead, *viz.*, 207·2. In modern nomenclature, it is generally accepted that Isotopes are elementary substances having the same atomic number but different atomic weights. We know now that most of the chemical and physical properties of the isotopes of any element are identical.

Dr. Aston points out that orthodox science was very reluctant at the beginning to accept the view that elements with different atomic weights could have identical chemical properties and he says, "This reluctance of orthodox science to accept the theory was, I think, a perfectly natural and healthy reaction. Criticism very seldom destroys enthusiasm and is usually the best stimulant to further research."

The next advancement in the experimental study of isotopes was the 'parabola' method of positive ray analysis started by Sir J. J. Thomson. These investigations of Sir J. J. Thomson led to the discovery of the two Isotopes of Neon of masses 20 and 22. Aston points out that in these investigations he was associated with Sir J. J. Thomson and as a result of this association, he, after a series of difficult diffusion experiments, was able to show that Neon was not homogeneous by getting two samples of Neon which differed in density by about 0·7 per cent.

It is undoubtedly the mass spectrograph of Aston that placed the existence of Isotopes beyond any possibility of doubt. With the aid of the mass spectrograph, Aston showed that Neon consisted of atoms of mass 20

and 22 in relative abundance of 9 to 1, so that we get the mean atomic weight 20·2. Chlorine, bromine, krypton, xenon and others were analysed and found to be mixtures of Isotopes of different masses. It was established that the "whole number rule" indicated that atomic nuclei were built up of the units, protons and electrons, in appropriate relative numbers to give the atomic number. Dempster at Chicago, with a mass spectrograph of his own design, made Isotopic analysis of magnesium, calcium and zinc.

The two main methods of obtaining the necessary rays for analysis are (1) the ordinary gas discharge which requires that the element under examination should be volatile or should form suitable volatile compounds and (2) the anode ray discharge in which the compound of the element is the anode in a low pressure discharge. In this connection says Aston with truth that "Our knowledge of the mechanism of the discharge in both methods is far from complete, so that working with them is still rather an art than a science. The element of luck has played an important part in cases where the properties of the materials are unfamiliar and unfavourable to the conditions of the discharge."

The four elements, palladium, iridium, platinum and gold, remained without mass spectrograph data. Recently, however, Dempster has analysed platinum and finds five Isotopes. Gold, he says, is single. It is found that no element of odd atomic number has more than two Isotopes. In the case of even elements, *i.e.*, elements with even atomic numbers, the finding is different; tin, for instance, having as many as eleven Isotopes ranging from 112 to 124 in mass numbers. It is also found that upto the number 210, a stable elementary element atom is known for every number, and often there are 'Isobares,' that is, there are elements with the same atomic weight but different atomic numbers.

Next Aston discusses the technique of the determination of the relative abundance of the Isotopes of an element. The question of 'packing fractions' and the contribution of Bainbridge to the study of Isotopes are discussed. Then in an account of the sensational discovery of the now well-known Deuterium, the heavy Isotope of hydrogen with mass number 2, of the Isotopes of oxygen 17 and 18 and other relevant questions, are taken up for consideration.

"In the field of Isotopes," says Aston at the close of the address, "as in so many fields of physical and chemical research to-day, the objective we now aim at is the next decimal place, an elusive object which always appears to be running away from the observer, like a distant spiral nebula..... In artificial radio-activity and transmutation we see the real beginnings of a great new subject, the nuclear chemistry of the future..... Armed with reliable equations, and thereby with more and more definite knowledge of nuclear construction, he (the chemist) will transmute and synthesise atoms as his elder brother has done molecules, with results to be wondered at and possibly even misused by his fellow creatures. I foresee a time, not immeasurably far distant, when it will be possible for us to synthesise any element whatever, whenever and wherever we please; alchemy indeed in the service of man."

Chemistry.

President: PROF. W. N. HAWORTH, F.R.S.

THE MOLECULAR STRUCTURE OF CARBOHYDRATES.

PROFESSOR W. N. HAWORTH'S address is a welcome synopsis of current views on the architecture of carbohydrates, the class comprising sugars and the various forms of starch, cellulose and vegetable gum. To their economic and alimentary importance must be added their significance in the development of organic chemistry, throughout whose course the attraction of their changes and the repulsion of their properties have afforded its practitioners a constant allurement. They are so closely interwoven in the fabric of this development that organic chemistry without the carbohydrates would seem as unsymmetrical as the Taj Mahal with only three principal minarets.

Since the death of Emil Fischer a substantial change in the structural presentation of sugars has been consolidated. Fischer's most notable activities in this field were directed towards elucidation of configurational problems, and although he did not exclude the possibility of a cyclic structure, in fact adopting it for the glucosides, common practice continued to represent the parent sugars by hydroxylated carbon-chains including an aldehyde-group (the aldoses), or a keto-group (the ketoses). It is these groups that lead to the glucosidic, or the oxide, ring. Haworth (1925) presented a structural

model of glucose in the form of a six-atom cycloid, and the supporting experimental evidence now accumulated is formidable.

By the new (amylene oxide) presentation, normal glucose and fructose are derivatives of tetrahydropyran, and are therefore denominated pyranoses, while the γ-isomerides are recognised as derivatives of tetrahydrofuran, and are classified as furanoses. This redisposition has been made without requiring to disturb the configuration of hydrogen atoms and hydroxyl groups previously distinguishing the hexoses, which are now identified by names recalling both origin and structure, *e.g.*, glucopyranose, mannopyranose, glucofuranose, fructofuranose, etc. From this groundwork, disaccharide-formation follows the two-fold course revealed by the properties of the products, namely, those (*a*) which retain a potentially free carbonyl group, *e.g.*, maltose, lactose, cellobiose, and (*b*) which have lost this feature, *e.g.*, sucrose, trehalose ; and it is now possible to identify the carbon atoms of each combining pyranose or furanose which is concerned in the union. For example, maltose-formation involves carbon atoms 1 and 4 of the two combining glucopyranose molecules, while sucrose arises by uniting carbon atom 1 of glucopyranose with carbon atom 1 of fructofuranose. This type of diagnosis has latterly been greatly extended, penetrating the obscurities of the polysaccharides inulin, cellulose, starch and xylan (wood gum).

The majestic edifice of carbohydrate chemistry now rising on the foundation so truly laid by Fischer, and to which Haworth and his collaborators have contributed very substantially, could not have reached its present ample proportions without the device of methylation, introduced by Purdie and Irvine (1903), and with suitable modification since applied to di- and polysaccharides. Crystalline tetramethylglucose heralded a long series of polymethylsaccharides whose physical properties are more helpful than those of the parent hydroxy-compounds ; they are easily crystallisable from organic solvents, show definite melting points, and in some cases may be distilled under greatly reduced pressure. It was from a study of tetramethylglucose and of its methylglucoside that the pyranose-form in hexoses and pentoses came to be verified ; and the survival of polymethylated hexose-units from careful hydrolysis of polymethylated di- and polysaccharides has vividly illuminated the structure of these elusively complicated materials. The address under review portrays in striking manner the combination of cellobiose-units in a continuous chain to form cellulose, and compares the latter with starch, correspondingly formed by combination of maltose-units.

The picture thus presented harmonises with the results of X-ray analysis, and a chemical estimation of the cellulose chain-length has indicated 200 glucose-units as the most probable approximation. Some explanation must therefore be given to account for the wide incongruity between this molecular weight and that indicated by physical methods, and in Haworth's view this is owing to natural cellulose consisting of aggregated chemical units, associated perhaps by co-ordinated co-valencies, catamaran-wise. Many of the changes incurred by cellulose in the laboratory and in industrial processes involve a disaggregation of the physical unit preceding chemical transformation into derivatives.

Elucidation of the starch-complex reveals corresponding general features. Methylated starches from three sources are uniform in the chain-length of their chemical unit indicating a combination of 25 glucose-units, while the physical method of molecular weight determination manifests a far higher value. As in the case of cellulose, this discrepancy may be explained by aggregation of chemical units, because, by a simple method, Haworth has prepared a disaggregated starch which, in the form of its acetyl and methylated derivatives, has the same molecular weight as determined alike by viscosity and by gravimetric assay of the terminal group. This disaggregated starch is not degraded, but is probably the chemical unit, capable of undergoing re-aggregation to physical assemblages of increasing viscosity. Glycogen specimens, on the other hand, with chain-lengths of 12 or 18 glucose-units, display little or no tendency to molecular aggregation.

The polysaccharides levan (from grass-leaves) and inulin, analogous condensation products from fructofuranose, are reviewed in the address, and lichenin (from lichen cell-walls) is shown to resemble cellulose in structure with a considerably shorter chain-length of about 80 glucose-units. Xylan (from esparto) has 18 or 19 xylopyranose-units terminated by an arabofuranose which can be removed intact, when the residual chain comprises only xylopyranose-groups. At least one method by which Nature effects

the synthesis of these complex molecules is indicated by reference to the constructive action of micro-organisms on solutions of glucose and other sugars, when the resultant polysaccharides are found to contain hexose-units in which, very surprisingly, the glucose-configuration has been changed. Finally, it is anticipated that advances in medical knowledge will arise from polysaccharides having immunological function, which are not simple in structure, and probably have a molecular weight exceeding 2,000.

It is unusual to find in the lay press a pertinent inquiry relating to carbohydrates but Dr. A. S. Russell, writing in *The Listener* (August 28, p. 361), asks why the *d*-glucose-configuration holds a unique place among the sugars. When there are sixteen possible distributions of hydroxyl groups and hydrogen atoms why, he asks, should the dice be loaded so heavily in favour of *d*-glucose? It seems to suggest that Nature is not a communist. The question is well worth asking, and perhaps Professor Haworth will one day be able to answer it.

Geology.

President: PROFESSOR H. G. A. HICKLING.

SOME GEOLOGICAL ASPECTS OF RECENT RESEARCH ON COAL.

THE conception that coal is a metamorphic rock is ancient but evidence to establish this has been obtained only by recent researches. In the eighteenth century knowledge about coal was confined to the conditions under which coal had been formed—the *in situ* and drift theories of origin of coal—but little was known as to the nature and general mass of the rock itself. There was uncertainty, as to whether the major differences in coal were determined during the accumulation of the deposit, by the kind of plant materials and by their state of decay or whether the chief factor was the effect of physical forces brought to bear on the deposit after its burial in the crust. The recent researches of palæobotanists and fuel technologists have clarified these points to a considerable degree.

The uncertainty regarding the structure of the coal in earlier days was due to the difficulty of preparing thin slices for microscopic examination. Henry Witham in 1833 prepared sections of coal and from their studies William Hutton concluded that every variety of coal is of vegetable origin and the difference of the nature of these varieties has most probably arisen from an original difference in the nature of the vegetables of which they were composed. During the greater part of the eighteenth century progress in the study of coals was slow, though bleaching and macerating agents were used to elucidate the plant structures. The modern period of coal petrology is the offspring of the palæobotanical research of the nineteenth century and this work has given a precise knowledge of the structure of the plants which formed the coals and a clear picture of the condition of some of the coal peats at the time of their deposition. During this period the technique of microscopic examination and section cutting advanced rapidly due to the researches of Jeffreys Theissen, Lomax, Winter and Seyler.

Before the time of Witham and Hutton coal was regarded as a deposit from solution —a kind of vegetable extract, but microscopic examination limited this idea by revealing the abundance of organised plant structure in coals and the abundant presence of the characteristic "uniform brown substance"—the "lignitoid material" of Jeffreys or the "anthroxylon" of Theissen. Stopes classified the types of coal substance seen in bituminous coals and gave an account of their constitution as revealed by the microscope, and emphasised the laminated character of coal. Later researches have shown the abundance of plant structures in "coal substance" and that coal is a characteristic mixture of this "coal substance" and other ingredients. However the "uniform brown substance" could not still be resolved entirely and at present there are two views regarding the nature of this material. Some contend that it is entirely made up of plant fragments, while others suggest that a large part of the substance decayed to the condition of a true fluid which solidified as a structureless gel which acted as cement to the whole mass. Two distinctive features of this substance are the low ash content and little variation in its organic composition as compared with other constituents of coal. This substance may be called "Vitrinite".

The other components of coal, though subordinate in quantity to vitrinite, determine largely by their varying quantities different varieties of coals. Chief among these is fusain or "mineral charcoal" formed from woody tissue and characterised by low hydrogen and oxygen content. The next group of coal components may be designated the "high hydrogen group",

the outer coatings of stems, leaves and spores, which are characterised by an accumulation of waxes, fats and resins. Their presence alters the composition of coal specially in hydrogen content. There is still another ingredient of coal characterised by its minute state of fragmentation a sort of residuum to which Stopes has given the name—micronite. The cannels and boghead coals have different structures and have the distinctive presence of microscopic oil-bearing algæ—essentially similar to the living oil alga—*Botryococcus braunni*. The presence of this constituent has the striking effect of increasing the hydrogen content of these coals.

An examination of the types of coal aggregate shows variations in the quantity of coal components which possess different grain sizes. As the average size of the particles in any coal aggregate decreases, the proportion of vitrinite lessens while there is a corresponding increase of the "high hydrogen group" and the micronite, thus determining the exact quality of coal. Differences in coal have resulted not only by the type of aggregate but also by the degree of alteration (the rank of the coal) to which the original composition of the aggregate was subjected. There is considerable divergence of opinion in assessing the relative importance of these variable factors in determining the differences in the quality of coal. Chemically considered coal components consist mostly of carbon, hydrogen and oxygen,–these being marked variations in their hydrogen content. Representative analysis of bituminous coals shows the following limiting variations, hydrogen 4·5 to 6, carbon 65 to 90 and oxygen 5 to 30%. The variation in hydrogen content of these coals is largely determined by the character of the original materials but the carbon : oxygen ratio is determined solely by other considerations. It is this difference of oxygen content which denotes the rank of coal distinguishing the lignites, bituminous coals and anthracites.

Thus we see that the rank of a coal is the measure of the alteration in composition which the deposit has suffered in consequence of rise of temperature and increase of pressure resulting from burial in the crust. Observations on the relation between the rank of coals and their distribution in the rocks have shown that change of rank has been caused by geological factors and is quite independent of the original constitution of the seams. This relation is expressed by Hilt's law which states that "in any vertical section the deeper seams are of higher rank than the upper seams". Experimental evidence points to the fact that pressure is more responsible for inducing differences in rank rather than temperature. It is thus obvious that coal can be used as a combined "geological thermometer and barometer".

Zoology.

President : PROF. F. BALFOUR-BROWNE.

THE SPECIES PROBLEM.

PROF. F. BALFOUR-BROWNE in his address on "The Species Problem" questions the validity of Wallace-Darwin concept of the Theory of Natural Selection and comes to the conclusion based on an intensive study of the habits and structure of water beetles that Natural Selection plays but a small part in the origin of species.

The carnivorous group of beetles Hydradephaga and vegetarian group Hydrophilidæ affect isolated habitats which can be grouped as ponds, lakes and rivers and the beetles occupying any one of these habitats form a well-marked community. Each community under an intensive scrutiny reveals a large number of species. This has brought to light an interesting feature that the species composition of a community of insects affecting one habitat differs fundamentally from that of another.

The classification of the habitats into ponds, lakes, etc., is purely an arbitrary one as one passes into the other imperceptively due largely to the frequent changes happening in these habitats. It is interesting to note that a changing habitat is closely associated with a changing community.

Prof. B. Browne discusses further whether adaptation in response to a keen struggle for existence is an explanation sufficient to account for the origin of species. He cites a number of examples to suggest that choice plays a part not merely in determining the food of insects but that it also has a profound influence in the selection of the habitat and draws the inference that neither soil nor plant environment has any direct effect on the community. He suggests that the active factor must be the internecine strife of the animal population.

The purity of a community is usually maintained by the destruction of immigrants and at no time of the year do we find a general mix-up of the communities; for

even new generations seem to emigrate exercising a well-marked choice in the selection of their new habitats. The examples cited show that "Choice plays a part in the composition of these communities." If choice should account for localisation and distribution of species, an even more important rôle is suggested for choice in the study of biological races. By careful experimentation it is possible specially in the case of vegetarian species to induce the insects to develop a decided preference to certain kinds of plants so that we may ultimately succeed in getting at a race of beetles which restricts itself exclusively to that food plant. The changes of habit have not produced any morphological changes to any appreciable degree, though Cameron and Nuttal seem to suggest certain changes in the thickness and length of the antenna and the length of the legs of the insects due to changes in the feeding habits. Nuttal associated these changes with physiological influences.

A study of any group shows that species differ in their relation to one another. Some form clusters while some stand apart. The clustered species of water beetles are usually members of the same community or sometimes even inhabitants of the same districts. In the several examples quoted it is suggested that there is no interbreeding between the related forms and no intermediates have been recognised. However, it is suggested that some clusters may prove to be intermediates between biological races and species.

Prof. B. Browne's study of a series of insects with Deronectes depresses and D. elegans occupying the extreme ends with well-marked specific characters and with an equally well-pronounced geographical distribution may in due course offer an answer to the question whether the climatic or edaphic conditions have a control over species formation.

The inheritance of acquired characters is still a pious hope and proof of it is still lacking. The study of water beetles does not offer any evidence that species characters distinguishing pairs are really heritable. A study of other groups of animals shows that acquired characters do not disappear directly after the stimulus which caused them has been removed.

Work on Drosophila and Oenothera has shown that new characters may arise from changes in the chromosomes of germ cells and the question whether the ancestors of water beetles got into water by choice and then developed adaptive characters or did the changes in form and structure create the choice by reason of which these beetles took to an aquatic life, still remains unanswered.

An analysis of the characters on which classification has based shows that in some cases special structural modifications have enabled the insects to live in water while in others functional changes explain adaptation.

Prof. B. Browne suggests that the species characters are for the most part non-vital and some of the main characters from which the classification of Dystyscidæ is based show a progressive development. These are not vital to their possessors since the various stages in their developments exist side by side and natural selection could have nothing to do with their progress.

The chromosal theory of heredity points to a chromosal control of characters and the orthodenetic tendencies may be the outcome of mutations, caused by external stimulus. Some authors look upon directional evolution as an inherent problem of the organism. If function can cause variation in structure, these evolutionary lines may be responses to the physiological activities assuming that acquired characters are inherited. Inheritance of characters must also depend upon the effect on the germ-cell chromosomes of changes and habits, physiological activity and in the structure of the individuals. The chief struggle for existence seems, therefore, to be in the chromosomes which perpetually endeavour to maintain their normal constitution and relationship.

Geography.

President: PROFESSOR F. DEBENHAM.

SOME ASPECTS OF THE POLAR REGIONS.

THE remoteness of the polar regions from the centres of civilization, and the inhospitable conditions of their climate, no less than the dangers surrounding their approach had delayed their exploration until comparatively modern times; but with the scientific advances recently made in navigation, and with the perfection of equipment for long and dangerous voyages, the search for these unknown areas has been renewed with considerable success. The snowy skies and ice-encumbered seas must make stern demands on the physical endurance of voyagers, and evoke their most heroic

qualities, seldom witnessed under the soft-handed influence of temperate latitudes. In the fifteenth and sixteenth centuries, the motive inspiring the voyages into the unchartered frozen zones of the earth's surface was the desire to discover new routes to China and India for the expansion of trade, and new continents for the extension of territorial boundaries. Although the discovery of more favourable and easy routes to the East, and of new continents for economic development and colonisation, put the political interest in the polar regions temporarily in the background, their geographical problems continued to stir the imagination and the spirit of daring of the voyagers. It may not be the privilege of all geographers, nor even of all the intrepid explorers, to visit personally the drifting of ice-masses and blinding snow storms which surround the Arctic and Antarctic seas. It is, however, within the reach of all to obtain a clear and vivid picture of these strange and weird regions from the published descriptions of the explorers, the accounts of the Press, and the exhibition of motion pictures; and in the perusal of the rapidly growing literature of the polar regions, one is thrilled by the dangers encountered, and is fascinated by the courage and determination of the heroic explorers, so much that one rarely gets a comprehensive view of the territory explored as a whole. This strong human element inevitable in such works, appeals to the emotions of the reader and must account for regarding the polar regions as lying outside the real comity of the world. From the days of Pierre Bouvet and Martin Frobisher down to more recent times, the principal aim of the promoters of the polar expeditions has been one of ultimate gain in securing vested interests in hunting, fishing and mining, and the cryolite mines of Ivigtut and the ivory of primeval mammoths, the furs of seals and bears and the blubber of whales invested commerce in the North with a strange romance.

The story of Arctic adventure and trade has a grim and melancholy aspect in that several of their ventures have brought animal life in the polar regions almost to the verge of extinction. With the progress of long-distance aviation, the idea of using the northern latitudes for passenger and freight traffic in the air has become insistent, and if the greatly improved aeroplanes are diverted from their legitimate purpose, and are used to explore the possibilities of the wealth of animal products, fatal consequences will overtake the most interesting and valuable animals known to science. The cupidity of man and his unwillingness to co-operate are at the bottom of all international troubles. The wealth of the Antarctic and Arctic regions lies in the seas which surround them, which are free to all nations, but their claims to ice-covered land sectors without harbours and without any economic value, have been the subject of international negotiations which illustrate that there is always an aggressive and capricious spirit in international affairs. "It is probably too late for any alternative arrangement to be adopted, but had there been a League of Nations in existence at the beginning of the century, before any claims had been laid in the Antarctic, the protection and administration of this last and least useful continent would have been a most appropriate subject for League administration as an international park of vast proportions which should be open to all nations who would respect its amenities." The passion to possess Antarctic lands arises from the voyagers' tales of their untapped mineral resources and at the moment, nations are apt to forget that they are covered by thick ice-sheets or are rendered inaccessible by topography and climate. Professor Debenham concludes the section of his address relating to the economic survey of the polar regions, by expressing the hope that future developments in the science of physics and of engineering might enable man to harness the Antarctic blizzards and the great ice movements for generating power in the maintenance of industries when coal becomes scarce and oil exhausted, and all the water-power in the temperate latitudes is fully utilised.

If we ask ourselves why so many people have risked their lives in the past by going to the polar regions for other than economic reasons, the answer must be "the lure of the wide open spaces" with their immense solitary grandeur, and the irresistible spirit of curiosity to penetrate the unknown. There is the possibility of the holidays of civilised people, being taken nearer to the polar latitudes, with the increasing rapidity and safety of air transport, and it may not be a fantastic forecast that "there may be a Brighton of Spitzbergen, a resurrection of the Smeerenberg of two centuries ago". The consideration of the polar regions as a holiday resort for the citizens of crowded

cities raises the question of where health is best to be sought. It is true that the temperate zone, provided it is not too far from the sea, is perhaps the healthiest belt for man, but the polar regions are definitely the healthier segments of the earth's surface for the simple reason that the climate though bleak for man must be impossible for disease-bearing vermin. Apart from the healthiness of these regions, the value of their climate for curing diseases contracted in temperate latitudes is an aspect of geographical study worth investigation. Perhaps medical researches on the curative proportions of the air in the polar lands especially in pulmonary affections might yield results which would favour residence in them rather than in the Sanatoria of the Alps, and in such circumstances the polar regions have an importance to mankind far more valuable than all the industries they will ever support. This is an aspect of medical research which falls within the purview of international bodies such as the Rockfeller Foundation, which has done so much for remedial medicine.

Professor Debenham, referring to the value of polar explorations in regard to science, both pure and applied, pointed out that the subject of meteorology was likely in the future to gain most by a prolonged and intensive investigation in high latitudes. The phenomena of magnetism and aurora, which are akin to those of meteorology, are best studied in the higher latitudes which favour investigations of ionosphere. The science of geology, especially in its branch of tectonics though there must be difficulties in the study of rocks covered by sheets of ice, must be interesting the nearer one gets to the axis of earth's rotation. The geologists attached to the British Graham Land Expedition are engaged in the investigation in the Antarctic continent how and where the folded ranges of South America and Graham Land merge into or butt against the faulted escarpments of the Australian Sector of the Antarctic. The discovery of coal beds by Admiral Byrd's geologists, within 300 miles of the South Pole, and the controversies whether the Poles have shifted in the past and whether continents are drifting and other similar geophysical problems must keep the attention of geologists on polar lands. The biological problems of high altitudes, such as the drift of oceanic waters, the presence or abundance of plankton and the movements of the great animals, have already made rapid advances through researches conducted by the Discovery Committee over all the waters of the Antarctic ocean. The value of the polar regions as an outlet to the spirit of adventure and urge for exploration is psychological rather than geographical, and practically in all polar expeditions, the motive is a curious combination of an urge to test the summit of human qualities and a desire to accomplish a great deed for the sake of the deed itself.

The potentialities of these uninhabited zones are undoubtedly great and the interest in the polar regions is bound to become increasingly practical with the progress of our knowledge of the higher latitudes in all their multifarious aspects.

Engineering.

President: MR. J. S. WILSON, F.C.G.I., HON. A.R.I.B.A., M.I.C.E.

THE STABILITY OF STRUCTURES.

THE meaning of stability is not easy to define. In dynamics and mechanics we have stability of steady motion and stability of equilibrium of position and of friction. In civil engineering it is usually applied to the power of a structure to withstand for an indefinite time all the loads and forces that may be brought to bear on it.

The great pyramids of Egypt, the tall brick chimney that stood till recently at St. Rollox in Glasgow, the masonry dams built across valleys to impound water and arches constructed across rivers and in great buildings are good examples of stable structures. The strength and stability of these structures depend mainly on the resistance to compression offered by the materials, *viz.*, stone or brick. In the case of the complimentary form of structure, such as a suspension bridge, they depend almost entirely on the tensile resistance of the chains or cables. In most iron and steel structures such as girder and canti-liver bridges the resistance of the material to both tension and compression contributes to their stability in equal proportions. In reinforced concrete the great strength of concrete to resist compression is combined with the power of steel to resist tension. Due to the facility with which it can be built and shaped it has been applied to many large structures which present problems in stability of considerable interest. Tunnels of masonry or brickwork and cast-iron lined tube tunnels, subject to the pressure of great depths of earth, are forms the stabilities of which are not easy to calculate.

In estimating the stability of a structure the principal factors are the strength or resistance to rupture of the material and the balance or direction of the forces or loads brought to bear on it. In structures subjected to prolonged stress the factor of safety is a vital consideration and the correct factor of safety to be adopted, in each individual case, has still not been accurately fixed and, so far as civil engineering structures are concerned, the advance made in this direction has not been very great.

The rupture or breaking down of a structural element by a force is dependent on the detail of its incidence and the resulting intensity of the stress induced in the material.

The conception of action of forces along lines was introduced at an early stage. The position of such a line with respect to the boundary of a member offering resistance governs the distribution and intensity of the stresses in the material. In estimating the intensity of stress the position of the line in a lamina of the part under consideration is usually considered and in it the distribution of the stress follows the "Trapezium Law" which is a particular case of Galileo's solution of the beam problem.

In a pier or buttress which supports and at the same time resists the thrust of an arch the line representing the resultant of the weight and thrust of the arch is deflected downwards by the weight of the buttress and the shape of the structure has to be so decided as to keep this resultant line of pressure as far as possible near to the centre of pressure so as to obviate very high concentration at one end or appreciable tension at the other.

This rule applies to all cases of masonry such as ordinary walls, abutments, piers, retaining walls, dams and arches.

In this connection the problem of the masonry arch which is very interesting deserves special mention. The arch form of construction has been known for thousands of years and several magnificent arches built by the Romans are still in very good state. Although the arch form of construction was generally used there was always a feeling of uncertainty as to their strength and stability.

Up to the first half of the 19th century knowledge of the strength and characteristics of materials and of applied mechanics was not sufficient to establish or disprove the accuracy of the various theories propounded from time to time and any efforts made in the problem depended almost as much on dialectics as on mechanical principles. Throughout the 18th and 19th centuries mathematicians tried to find the exact form of the line of thrust that would ensure equilibrium in a mass of masonry bridging a void bounded by the horizontal line representing the road on the top and the intrados of the arch at the bottom shaped to conform to the line sought. The effect of hollow spaces over the haunches was investigated also and the influence of a moving load was regarded as negligible.

The correct shape of the arch to be adopted was also a point in dispute and the indefiniteness on this point was so great that about the year 1759 a controversy arose between the two designs submitted by two persons, Mylne and Gwyn, for a bridge, across the Thames at Blackfriars, one with an elliptical arch and the other with a semi-circular arch, and it was held that elliptical arch was stronger than a semi-circular one contrary to the every-day experience of the egg being weaker along the sides than on the ends.

Differences of opinion on the correct proportions of an arch also were very sharp. Some maintained that the thickness of an arch at the crown should be proportional to the radius of curvature while others held that the span of the arch should be the governing factor.

These contradictory opinions of the people who were considered to be authorities on the subject did not help architects and engineers who went on taking additional precautions by binding stones with iron cramps and for many years architects and builders were extraordinarily lavish in their use of cramps even in places where they could have no beneficial effect, notwithstanding the fact that these cramps did more harm than good to structures by corrosion.

Fine masonry arches of 300 feet span have been built. The construction of arches of larger spans has been made possible by improved technique in building. For longest spans reinforced concrete has now superseded masonry and arches with spans as great as 590 feet have been constructed.

In his monumental work called *Grandes Voutes* Paul Sejourne has given particulars of all arches of appreciable size throughout the world with details of construction and comparative analysis of the proportions. But the mathematical theory of the stability and strength of the arch, however, is of comparatively recent solution, due mostly to eminent engineers like Unwin and

Rankine. It may be added that Rankine's mathematical treatment of the subject has been further developed by his pupils, Alexander and Thomson.

The problem of the stability of masonry dams had exercised the minds of engineers and mathematicians for many years and the failure of the Bouzey dam in France in the year 1895 gave prominence to the subject. The maximum pressure on the masonry was the only factor considered in calculating its proportions in designing it and it was held by some that the failure was due to its incapacity to withstand the great tensile stress brought to bear on it and by others due to shearing. After the disaster, the French Government introduced a regulation that on horizontal joints of dams there should be a vertical compressive stress at the water face equal to not less than the water pressure at the joint. In 1904, Prof. Karl Pearson and Mr. Atcherley published a memoir entitled "Some Disregarded Points in the Stability of Masonry Dams" in which they stated that although a dam might satisfy the usual conditions regarding the stress on horizontal planes, it might still be subjected to dangerous tensile stress on vertical planes in the vicinity of the down stream toe. But the elaborate and careful experiments held jointly by the late William Gore and the President on these points showed no evidence of the tensile stress at the down stream toe; the shear stress diagram was practically a triangle with the maximum at the down stream edge and the vertical stress distribution agreed substantially with the Trapezium law. These experiments helped to re-establish the confidence in the method that had been in use for estimating the stability of masonry dams. During the last few years, investigations, both experimental and mathematical, of problems relating to the design of concrete dams and curved dams have been made in the United States. The influence of heat, both natural and that generated by the setting of cement, on stresses and stability has received much attention.

The suspension bridge is a fascinating type of structure and there have been astonishing occurrences in the course of the development of its design and stability. Suspension bridges formed of strong flexible climbing trees or roots have been used by primitive people. Examples made of wrought iron appear to have been in existence in the eighteenth century. Telford's famous bridge across the Menai Straits with a span of 570 feet completed in 1826 and one built across the Thames at Marlow by W. Tierney Clerk, F.R.S., in 1829 are still in use. The former is of the simple suspension type; the latter was the first to be built with stiffening girders. A supposed improvement was introduced by a Mr. James Dredge in 1836, which was much applauded and several bridges were built according to his specifications, some in England and some in India, all of which however failed. These failures created a strong prejudice against suspension bridges of all kinds and retarded their development.

The flexibility of the suspension bridges under heavy moving loads is a source of trouble and of wear and tear of the platforms. Nevertheless, when the chains are pulled by the loads into a line of equilibrium, so long as the anchorages are secure and the towers are sound, the stability depends solely on the tensile strength of the chains, and under these conditions almost all suspension bridges have a substantial margin of strength or stability. If over-loaded, long before the rupture of the chains would occur, the sagging or deformation of the platform would act as a warning. Where the ultimate strength depended mainly on the resistance to compression of the platform, as in Dredge's bridge and others built about the same time, the failure by the buckling would be sudden and disastrous.

In the modern suspension bridge the stiffening girder is as important a feature as the chain or cable and its introduction has made it possible to construct the gigantic bridges in the United States. The latest example is of a span of 3,400 feet. Cables composed of thousands of steel wires, four times as strong as iron, take the place of iron chains and the flexible timber platform has been replaced by deep steel stiffening girders with upper and lower decks providing double tracks. Instead of the stability of the structure being a matter of dispute and of the extraordinary uncertainty as before, the stability is now determined and gauged by calculation based on applied mechanics.

Anthropology.

President: SIR ARTHUR S. WOODWARD, F.R.S.

RECENT PROGRESS IN THE STUDY OF EARLY MAN.

SIR ARTHUR WOODWARD'S address on the recent progress in the study of early man is a

condensed account of the researches leading to the establishment of a number of genera of prehistoric man known to-day. Sir Woodward is admirably fitted for his task, being not only an anthropologist but a geologist and a palæontologist as well.

Any history of early man is closely bound up with the history of mammals associated with him as well as the implements he used. And a correlation between these three factors is a study which has often received scant attention and the more than usual interest in the address lies in the fact that Sir Arthur Woodward has taken all these facts into consideration in adjudging the value of the different human remains.

The most significant fact that has emerged out of the studies on fossil man is that man did not originate in Europe and the fossils known from this continent belonged to men who were immigrants from some other region. The investigations of Sir W. Boyd Dawkins on the mammals associated with early man in Europe have all pointed to the same conclusion, that they are immigrants from the Arctic regions, from Asia or from Africa. Africa as the home of early man is known only by a single skull of uncertain age named Australopithecus by Prof. R. A. Dart in 1925. While this skull which belongs to an ape certainly shows more human characters than does that of any other existing ape, a complete account of it is still being expected. It is on the other hand more likely that the origin of man is to be traced to Central Asia and the geographical distribution of the known fossils of early man is quite in consonance with this view.

The geological age of Eoanthropus from Sussex is the most difficult to determine but a close examination of the nature of the stratum as well as the mammals that occur associated with this fossil goes to show that Eoanthropus belongs to the beginning of the Pleistocene age. The difficulty is much less in the case of *Protanthropus heidelbergensis* which was found in association with mammals typically lower Pleistocene and it is the general opinion that it is unlikely that there is much difference in age between the Piltdown and Heidelberg men.

Pithecanthropus, discovered in Java, has been said to belong to the beginning of the Pleistocene period. The more recent Sinanthropus found in a cave in China and associated with a number of characteristic mammals and even with the remains of fires, seems to have been a contemporary of Eoanthropus and dates back to the early Pleistocene period. This latter skull is important in that it combines the characters of the other skulls.

Geologically latest is the Neanderthal or Mousterian man and this marks a fresh stage in the history of the evolution of man, since by this time man had learnt to bury his dead. Later discoveries of the Neanderthal man in Palestine have definitely enabled us to think that here is the modern man in making.

Dealing with the fossil remains of man found in other continents Sir Arthur Woodward points out that the fossils found in Australia relate to a fairly advanced type of modern man, as Australia was separated from the rest of the world throughout the tertiary age. The fossils in North America are also recent and relate only to the later part of the Pleistocene age. The work of Dr. Peter Wilhelm Lund in South America also points to the same conclusion.

Physiology.

President: PROF. P. T. HERRING, M.D.

THE PITUITARY BODY AND THE DIENCEPHALON.

THE address is devoted to considering the anatomical and structural features and the functional activities of the pituitary body which until recently was an organ of great speculative interest. In 1832, its dual mode of origin was discovered, the gland being composed of a ventral evagination of the twixt brain (the nervous lobe) and an epithelial accession (Rathke's pocket) from the buccal cavity. This union of buccal epithelium with the nervous element appears indeed to be to some extent a symbiosis, a view which is supported by experiments of transplantation. The coming together at an early stage of development of the pituitary body of two hollow processes, the one from the dorsal surface of the buccal cavity and the other from the ventral wall of the diencephalon throws light on an obscure point in the evolutionary history of the vertebrates, containing perhaps a suggestion that the union denotes an old association between the alimentary canal and the nervous system not unlike what occurs in the invertebrates. Thus Rathke's pocket may be regarded as the vertebrate representative of ancient invertebrate mouth (Palæostoma) and a comparison of the pituitary body with the ascidian subneural gland as homologous structures is often

made in Zoological works. The history of the pituitary is one of great significance, and the epithelial components make up the greater part of the organ in all vertebrates, forming the pars glandularis (anterior lobe), the intermedia (intermediate lobe) and pars tuberalis (tuber cinerium). The fourth part, pars nervosa, is the derivative of the twixt brain.

The anterior lobe contains chromophobe cells (mother cells), which make up the greater part of pars intermedia,—which are able to give rise to acidophil and basophil cells. There is evidence to show that chromophobe cells with filamentous golgi networks give rise to acidophil cells and those with perinuclear golgi rings, to basophil elements. The relative proportion of these cells is liable to variation in the different parts of the pituitary and also in the same part under different physiological conditions. The histological character of the pituitary can be varied and changed rapidly.

The epithelial lobe, whose circulation is sinusoidal, provides for its secretion to enter the blood directly, which is obviously destined more for general purposes in the body than for action localised to its immediate neighbourhood. The posterior lobe (pars nervosa) contains granular particles, derived most probably from the epithelial investment and the ependyme cells and secretes the pressor substance and other hormones which in their activities do not differ from the extracts of the epithelial lobe. The secretion of the posterior lobe may be absorbed into the blood vessels, penetrate the adjacent nerve floor and also enter the cerebro-spinal fluid.

The pituitary body is closely bound up with the floor of the third ventricle, and non-medullated nerve fibres arising from cells in the supraoptic, paraventricular and inferior hypothalamic nuclei have been traced to pars intermedia, pars tuberalis and islands of epithelium in the pars nervosa, besides sympathetic nerve fibres and the carotid plexus. Experimental work supports the view that the nuclei in the diencephalon exercise a controlling influence upon the secretion of the pituitary, as is shown by the observations on the female rabbit, the removal of whose pituitary within an hour after copulation (but not later removal) prevents ovulation. An injection of the extract of the anterior lobe brings about ovulation, and it is reasonable to infer that the stimulus of mating induces reflexly in the rabbit sufficient hormone for the purpose in about an hour's time. Zondek refers to the pituitary sex hormone which sets the reproductive cycle going, and Harvey Cushing comments that the emotional self-starter resides in the diencephalon. Evidence is accumulating that the hypothalamus (comprising the tuber cinerium, copus mammilare, infundibulum and pars nervosa of the pituitary body, optic chiasma and subthalamic tectal region) is an important site of integration of the basic activities which are common to the life of all vertebrates. The pituitary body is an essential part of hypothalamus which controls the metabolism of solids and water, with its accompaniments of hunger and thirst, the regulation of body temperature, emotional reactions, sleep, mating and reproduction.

Hormones have been separated in more or less pure form from the anterior lobe which stimulate growth and exercise a controlling influence over many important organs of the body, the glands, thyroids, parathyroids, thymus, cortex of the suprarenals and the mammary glands. The gonadotropic hormone is probably a product of the basophil cells. Harvey Cushing and his co-workers have drawn attention to the changes in carbohydrate metabolism which are exhibited by patients and experimental animals in hyper and in hypo-pituitary states, and injections of anterior lobe extracts have been found to produce ketonuria, lipæmia and cholesterolæmia, in addition to hyperglycæmia and increased resistance to insulin. The posterior lobe furnishes an extract pituitrin which contains two active principles, a pressor substance (β-hypophamine, vasopressin or pitressin) and a substance acting upon uterine muscle (α-hypophamine or oxytocin). The hormone of the posterior lobe extract which produces a diuretic action, probably resides in vasopressin. Harvey Cushing expresses the view that the grey matter in the hypothalamus, possibly the nucleus supraoptics is an important cell station for the integration of nerve impulses regulating water intake and output, and that the hypothalamus and the posterior lobe of the pituitary body make up a neuro-epithelial structure, the parts of which are mutually interdependent in their functions. A multiplicity of actions can be evoked by the extracts of the posterior lobe but it is doubtful if all of them are normal functions.

The diencephalon and pituitary body form a working unit, having functions of far-reaching importance in the control of fundamental physiological processes. It is probable that the pineal body is another part of the same mechanism, but its functions are still obscure.

Psychology.

President: DR. LL. WYNN JONES.

PERSONALITY AND AGE.

DEFINING personality as an integration of all the marks of mind and body as affected by nature and nurture, Dr. Wynn Jones presents a most interesting review of recent attempts to correlate it with age. He accepts five great classes of factors in personality, namely: (1) intellect, (2) disposition, (3) temper, (4) temperament, and (5) character, regarding them as largely, but not entirely, independent variables in the weaving of personality. Difficult as are the qualitative aspects of the problem, their quantitative assessment presents at the moment almost insuperable obstacles, because among other fogs enveloping the subject, recognition of the onset of senility is astonishingly variable. The German investigator, Giese, lately invited newspaper readers to declare the age at which they first noticed signs of advancing years, and to specify the signs: analysis of the replies placed the average at 49, but the age varied with the individual from 18 to 82! What can you do with that?

This inquiry, although doubtless amusing to the newspaper readers, does not strike the layman as contributory to the investigation, because while some people notice the passage of years by disabilities of the body, others are more impressed by changes in the mind. Moreover, in the latter class, 38 per cent. recognised their increasing age by treatment received from associates, while 44 per cent. relied on self-diagnosis: it is curious to note that the remaining 18 per cent. resisted the suggestion of senescence altogether, some with indignation. Whether contributory or not, however, it does illuminate the complexity of the subject, compared with which the study of child-psychology, a happy hunting-field for psychologists during the past thirty years, is almost child's play. Nevertheless, attempts have been made to extend, with suitable modifications, the methods of child-psychologists to the subsequent five or six decades of human life, and some of these are helpfully reviewed by Dr. Wynn Jones.

Among them is E. L. Thorndike's *Adult Learning* (1928), which examined the changes in (1) amount, and (2) nature of the ability to learn displayed between 15 and 45, especially between 25 and 45. One definite outcome is that nobody under 45 need shrink from trying to learn in the belief that he is too old to learn. This is good news for the opsimath, or late learner, and an authoritative encouragement of university extension courses. "If he fails in learning it, inability due directly to age will very rarely, if ever, be the reason. The reason will commonly be one or more of these: He lacks and always has lacked the capacity to learn that particular thing. His desire to learn it is not strong enough to cause him to give proper attention to it. The ways and means which he adopts are inadequate, and would have been so at any age, to teach him anything." Here psychology confirms commonsense, and in this connection there should be noted a conclusion of W. R. Miles, namely, that when speed is the stressed element in an intelligence test for adults, then the decrement due to age is greater than it is when power in unlimited time is emphasised.

Quantitative results are more easily obtainable in the athletic field studied by Professor Charlotte Bühler (1933) to ascertain the effect of age on various motor abilities, from which it appears that those demanding a maximum expenditure of energy per second are associated with the youngest average age, while older athletes excelled in exercises demanding economy of effort and its optimum distribution. Thus the following scale emerges:—sprinters and long-jumpers (23·5); hurdlers, high-jumpers, pole-vaulters and weight-putters (24·5 to 25·5); long-runners, rowers, weight-lifters and hammer-throwers (25·5 to 31·0). In group sports distinguished from individual contests the sequence was:—boxers (21·9); wrestlers (22·3); footballers (23·8); hockey players (26·4); tennis players (28·5); polo players (up to 50). To these Dr. Wynn Jones adds (for 1934) cricketers (30 for batting, 30 for bowling; 34·5 for those exceeding 3,000 runs) and golfers (35 as the median age of the forty who headed the open championship; and 31 as the median age of thirty-seven open champions since 1894).

One of the most baffling and least easily

measured factor in assessment of personality is temperament, *i.e.*, as defined by psychologists, the influence, direct or indirect, of bodily metabolism upon the psycho-physical processes of the nervous system; but the address does not expand this vitally important element. In passing, it may be questioned whether this definition of temperament coincides with common acceptance, the above-mentioned influence in the lay mind being that exerted by general health, while temperament usually connotes a predominant quality, as in 'lively temperament,' or 'phlegmatic temperament'. An appreciation of the recently published *Diary of Robert Hooke* (*Nature*, September 7, p. 358), to which Professor Andrade has gracefully brought his wit and erudition, makes it clear that Hooke, "generally allowed to have been one of the greatest promoters of experimental natural knowledge, as well as ornaments of the seventeenth century" (Richard Waller), was a permanently sick man, victimised by chronic inflammation of the frontal sinuses. Nevertheless he passed the sixty-seventh year, but the temperamental effect of his disorder, his crooked figure and his shrunken limbs cannot be computed; how confusing to the age-personality connotation, therefore, would have been his treatment by modern therapy. Every middle-aged man can recall from individual experience unfortunate examples of personality influenced by health; so much so that the benevolent minded, in contact with a thoroughly objectionable temperament, instinctively seek a physical explanation, and commonly find it.

Another factor in personality not merely unexpanded by Dr. Wynn Jones, but even unmentioned, is matrimony. To the Indian observer this may not seem important, because in this country (*a*) to remain unmarried is most unusual, and (*b*) matrimony appears to present less variable impingements on personality than among Western peoples. In the other hemisphere quite a significant proportion of people with personality inviting study remain unmarried, while those who do venture on matrimony cannot escape a modification of their personality, sometimes profound, owing to its influence. This is perhaps more conspicuous in the United States, but it is easily recognisable elsewhere. Reduced to a simple form, this factor would involve examination of the woman's personality in addition to the man's, a complication giving fresh terror to this branch of psychological inquiry—or further attraction, according to the age and personality of the investigator.

Botany.

President: F. T. BROOKS, M.A., F.R.S.

SOME ASPECTS OF PLANT PATHOLOGY.

BIFFEN'S discovery that susceptibility and resistance of wheat varieties to yellow rust are inheritable characters, led plant breeders to evolve new varieties of crop plants, which while retaining the valuable commercial qualities of the older crops, would resist specific diseases. Genetical and selection methods have led to the successful control of certain wilt diseases but in certain cases the plant breeder is faced with almost insuperable difficulties, since there is often complete or almost complete linkage between susceptibility to a specific disease and high quality which is extremely difficult to break. Another problem which the plant breeder has to face is the fact that one crop is liable to attack by several diseases and resistance to one disease is transmissible independently for each specific disease. Again he has to reckon with the fact that a variety bred for resistance in one locality may become susceptible if transferred to a different environment.

Parasitic organisms are liable to evolutionary change just as their hosts are and one cannot therefore postulate that their parasitic proclivities will remain constant over long periods of time. New physiologic forms evolve both by hybridisation and by mutation, and this capacity of micro-organisms to change, introduces enormous complications into the problem of disease control.

Another advance in the control of plant diseases lies in the greater attention now paid to plant sanitation or plant hygiene. Such preventive treatment, following the same lines as in medical and veterinary sanitation, aims at the abolition of the sources of infection wherever possible. The efficacy of plant sanitation is best seen in intensive cropping in fruit plantations and under glass. For instance, by preventing the fungus *Stereum purpureum* from spring within and on the confines of fruit plantations, risk of Silver-leaf disease is appreciably reduced.

Seed-borne diseases are controlled by fungicidal treatment of the seed before sowing, the control of some epidemic diseases by spraying the shoot system with fungicides, and the

protection of wounds in woody plants against parasitic invasion have met with a considerable degree of success.

More care is now paid than formerly to growing plants under the best environmental conditions with a view to diminution of parasitic attack, including modifications of cultural practice which tend to favour the host at the expense of the parasite. The ecological study of disease in plants is only in its infancy, but it promises to be one of the most fruitful aspects of plant pathology.

Another branch which is receiving much attention at the present time and which will probably assume greater importance in the future is the influence of one micro-organism on another in the establishment of disease.

The effects of associations of micro-organisms in culture are often profound. A mixed culture of two organisms can often produce a result which neither of them alone can induce. Such an effect has been termed "synergism" by Holman and Meekison. One organism may change the substratum so that it becomes suitable for the growth of the other, but the interactions of the two associates on the original medium are sometimes of a more intricate nature.

The effect of micro-organisms on one another is frequently also one of antagonism. Two organisms may mutually inhibit the development of each other, or one may be greatly impeded in its growth by the other. In the latter case one organism may exercise some toxic influence on the other or it may utilise the available food material so rapidly as to starve the second organism. Factors of this kind may perhaps play an important part in the specificity of saprophytism exhibited by certain fungi.

Of particular interest and of great importance is the antagonism shewn by certain saprophytes to pathogenic fungi which invade the underground parts of their hosts: indeed it is not too much to say that a new chapter in soil microbiology has been opened with the recognition of this factor of biological antagonism. In 1923, Millard demonstrated that *Actinomyces scabies*, a commonly occurring soil organism which causes potato Scab, could be prevented from attacking potatoes by incorporating large quantities of green manure in the soil.

During the early development of plant pathology little attention was paid to the study of disease in plants of a functional kind, *i.e.*, to disease not induced by parasitic agency. In certain ways non-parasitic diseases of plants are more difficult to investigate than those due to parasites, and not much progress can be made with the elucidation of some of them until more is known about normal plant physiology. Warrington and Brenchley startled the botanical world some years ago by demonstrating that boron was an essential element in the proper nutrition of certain green plants. Since then Brandenburg has suggested that boron-deficiency in the soil is the cause of the serious "heart-rot" disease of sugar beet and mangolds. Another element having the property—formerly unsuspected—of exercising an important rôle in the nutrition of some plants is manganese. It has long been known that oats did not thrive on certain soils unless salts of manganese were added. On such land the oats were stunted in growth, the leaves were affected by grey blotches, and the plants died prematurely, the disease being known as 'grey leaf' or 'greyspeck'. Small amounts of manganese sulphate applied to the soil enabled a healthy crop to be grown. Samuel and Piper have shewn by careful experiments that minute quantities of manganese must be available in the soil to allow of the normal nutrition of oats and certain other plants. Such a disease as that of 'grey leaf' of oats is now known as a "manganese-deficiency" disease. Another interesting example of the importance of nutritional factors in the maintenance of well-being in crop plants is afforded by the researches of Storey and Leach on a grave disease of tea bushes in Nyasaland, which causes chlorosis and rapid death. They have demonstrated that this disease is due to insufficiency of available sulphur in the soil.

Educational Science.

President: DR. A. W. PICKARD-CAMBRIDGE, D.LITT., LL.D., F.B.A.

EDUCATION AND FREEDOM.

THE address is devoted to examining the two opposite tendencies at work in the world of modern Education; the one, a tendency more or less antagonistic to freedom and the other, a tendency laying claim to freedom in ways which it is not always possible to defend. The latter is reflected in a number of educational theories which

would so far as possible exclude discipline from life in the supposed interests of free development, and also in a certain impatience with all forms of authority, manifested by the younger generation. But the other tendency is the outcome of the political doctrines adopted in countries such as Russia, Germany and Italy, where we witness a complete subordination of the individual to the State, not only in his external life and action but also, so far as education and propaganda can achieve it, in thought and will. In all the three countries the method adopted is the same, namely, anything which runs counter to the ideas promulgated by the dictator is sternly discouraged. This phenomenon is not confined to Central Europe and its manifestation even in democratic countries is discernible. The great feature of party government in England is party discipline, which essentially deprives the individual of all freedom of action and speech, and the members of the party have to subordinate their opinion and will to the interests of the organisation to which they might belong. Naturally the schools managed by such parties will gradually acquire the rigidity under which the political organisations conduct the public affairs.

Some of the recent works in fiction such as Aldous Huxley's *Brave New World* and H. G. Wells' *The Shape of Things to Come* which are most popular with the younger generation, clearly envisage and apparently approve the political and educational systems based upon the complete elimination of individuality. "Democracy," says Wells, "asks people what they want; what is required is to tell them what they want and see that they get it." His new government was meant to rule not only this planet, but the human will. It is open to treat such works as fiction but the events of our own times show that the constructors of imaginary Utopias are almost prophetic. It has been shown in most countries that it is possible so to educate and to govern as to eliminate freedom of thought and life and to make human beings efficient cogs in an all-embracing machine and to convince them that that is the best life for them. The acceptance of such views in the political organisation will lead to a passive acquiescence of them in the field of education, with the consequence that the curricula of studies, the methods of imparting instruction and the teachers and pupils must come under a thorough-going espionage.

But is it not a fact recognised and practised from ancient times that individual freedom, subject to such a minimum of restriction as is necessary for life as a member of a community, is the indispensable condition of a good and even tolerable existence? Plato and Aristotle thought that it was the business of education to bring up young citizens in what they called the 'Spirit of Polity' and it makes all the difference in the world whether Russia, Germany and Italy substitute the word 'State' for 'Polity'. Where the State assumes the authority for directing and controlling education, the result must inevitably be a standardised and unresisting mentality, which education in the spirit of a polity of free men and women must above all train them to think freely and accurately and to desire to carry the results of their thinking into action. Such a freedom includes the power of the individual to realise the good, as he understands it, in his life, and the power to take an equal share with any other citizen in determining the action of the community in the realisation of public good as a whole. So far as the community is concerned, the ideal state will be a democracy in which every individual is free to realise the highest values, physical, moral and spiritual; and the realisation of some of these is only possible if he can enter into freely determined mutual relations, with others, participating fully in the life of the community, communicating his share of good to it, receiving his share of good from it.

Freedom desired for the individual encounters obstacles of more than one kind; and it is in a great measure with these that education has to deal. They are partly in himself, partly in the community. The powers of an individual to make a free and correct choice from out of the lower and higher values, obviously depends upon the training, as well as upon his natural endowments. Every one is greatly hampered by the effects of heredity, and by the influence of early environment. The whole process of education is to set the higher values before the immature mind in such forms as it can understand and encourage the habit of choosing them. The importance of such discipline depends upon the fact that without it, the immature personality may not discover that it has the freedom, to choose something other than that which immediately appeals to it. Discipline, correction and guidance reveal the power of choice; in

time self-discipline follows and freedom to pursue and realise ends or values increases. Much of the discipline imparted by education in the cause of freedom is apt to be counteracted by the faiths, prejudices and party feelings of the community. The interests of communal organisation do not always coincide with those of education and more often than not, the purpose and intentions of education are vitiated by personal rancour and malice of those entrusted with its management.

It must be remembered that before life is far advanced the simple problems and issues of early life are merged in far more complicated issues of the community, requiring the utmost clarity of thinking. For effective thinking the younger generation should have access to truth about facts and the mind should have been disciplined in the habits of working accurately and honestly. If freedom in political and private life is to be preserved, those who educate young men must put them in the way of obtaining truth about facts and of distinguishing truth from falsehood in what is presented to them and in their own reasoning. It is in this way that they can be trained to citizenship in democracy and to the conception that it is less a system of equal rights than a system of equal responsibilities and co-operative endeavour for the good of the community as a whole.

Dr. Pickard-Cambridge examines the relative values of the school subjects which afford opportunities for the formation of habits of careful and correct judgment. The task of the teacher is to encourage his pupils to think by the presentation of evidence or of opposite points of view; the desire of the politician is to prevent his adherents from thinking so that they may swallow his particular notions. It is in the school room that the dangers of dependent, unventuresome and servile mentality must be countered. Young people are much more likely to think for themselves within the framework of school discipline (which is scarcely felt so long as it is wisely controlled) and do think for themselves. Dr. Pickard-Cambridge next proceeds to observe how the system of public examinations as they are at present planned and conducted, militates against the results of education.

The suggestions made in the Presidential address as regards educational theory and practice are no matters merely of finance, administrative and political convenience, but of vital and immediate urgency if we are not unconsciously to bring up a race, which with its mind stunted, its capacity for freedom undeveloped, will fall an easy prey to the politician, the journalist and the dictator: and that if a free democracy is to continue, we must educate for it, for in many respects, the present educational practice is better calculated to produce a servile and passive mentality than to evoke an activity of mind and freedom of judgment worthy of free men and women.

Agriculture.

President: J. A. VENN, LITT.D., F.S.A., J.P.

THE FINANCIAL AND ECONOMIC RESULTS OF STATE CONTROL IN AGRICULTURE.

THE Presidential Address of Dr. J. A. Venn before the Agricultural Section of the current year's session of the British Association for the Advancement of Science deals not with any aspect of the service or practice of agriculture but, as the above title indicates, with some of the economic factors upon which the prosperity of agriculture is coming to depend more and more in recent years. It does not seem to matter how high or low efficient one's production may be, it is really, on the other hand, the price one's produce is able to fetch that is the deciding factor. This would indeed be a truism hardly worth stating were it not that in the modern state the prices of commodities are not regulated in the way known to economists by the interaction of demand and supply in a world market but by a whole battery of protectionist weapons, both offensive and defensive, whose result cannot be foreseen and which have to be constantly changed and adapted to varying conditions. It is the story of how Great Britain leaves off her *laissez faire* free trade policy and falls into line with the universal protectionist tendencies of the world, to what extent this change of policy has brought relief to agriculturists, what the cost has been to the State Exchequer, how conflicting interests like those of the home producer, manufacturer and the Empire producer, or again those of the consumer, middlemen, landlord, tenant and agricultural labourer are sought to be served and what a variety of purposeful measures of State action these have introduced—it is the story in fact of their new economic regime of the latest convert to protectionism and State control that Dr. Venn unfolds in his address. Frankly, he plays the rôle of only an

'expositor' and gives us little more than a narrative of these developments together with a picture of their historic background without attempting any criticism of the merits or imperfections of the measures or offering any suggestions or alternatives, or developing any particular theme or view. He alludes, however, in passing to various dangers and risks to which this kind of elaborate artificial propping by means of State control and aid may in time lead. It is not difficult to see that his sympathies are with the old-time free-trade policy and that like most British people he looks upon these measures as a necessary evil, perhaps only temporary in character to give place in time to the free play of natural forces whose result will admit of a reasonable amount of forecasting and of suitably providing against. He quotes the following dictum uttered recently by one of the world's dictators:— "What the situation calls for is the free movement of goods, of people, of capital and of credit," and adds that "We in these islands have more to gain than any other nation by such a consummation." This consummation is, we are afraid, a long way off, and will like the horizon keep moving farther and farther as long as nations can set no limit to their ambitions of conquest and domination, political or economic.

In his historic survey, Dr. Venn traces the close parallel that exists between the remedial measures against the depression at various periods including the present one and that many mistakes and much needless expenditure of money could have been avoided if only this parallel had been better known. The results of successive acts of amelioration by the State during the past are described, such as the wiping out, by remission of a big load of agricultural taxation, the provisions for the better housing, education and health of rural workers, the institution of small holdings and the provision for agricultural research and technical instruction for the farmers. Attention is also drawn to the change in the farming methods that has proceeded side by side with this State action, by which the British farmer turned from arable farming to the more remunerative fields of dairying, the production of fruit, vegetable and other foodstuffs of a luxurious character. The story is brought down to the period of the Great War and the rigid State control of agriculture necessitated by that crisis. Into this, however, the address does not enter, for Dr. Venn's main theme relates to the peace time activities of the thirteen-year period subsequent to 1922, during which the new measures of State aid and protection have been in full blast. He divides those thirteen years into two distinct periods, the first one being the period of subsidies, grants-in-aids and reliefs from taxation, and the second that of the control of home production and of imports accompanied by the imposition of protective duties. The several measures under the first are duly catalogued, their features being only broadly indicated, and the monetary gain to agriculture itemised and estimated. The estimate is interesting and is as follows:— wheat deficiency payments, £ 7,180,000; sugar-beet subsidy, £ 2,820,000; meat subsidy, £ 3,300,000; milk grants, £ 1,600,000; small holdings and allotments grants, £ 900,000; afforestation grants, £ 150,000; ministry of agriculture and development commission, £ 2,500,000; tax remissions, £ 15,000,000;—making up a total of £ 33,750,000. A deduction of £ 10,250,000 is made on account of payments by statutory wages by farmers bringing the total net gain to British agriculture to £ 23,500,000. The result has been an increase in the acreage of wheat, a new and prosperous beet sugar industry, an increase of 50% in milk cattle and so on, all of which may be taken to justify the expenditure incurred by the new policy. Dr. Venn points out in this connection that the chief beneficiaries of these grants have been the tenant-farmers and agricultural workers, but not the landlords, whose position has continued to deteriorate. But the landlord's wail is a familiar cry all the world over, for the tendency throughout has been to assist the actual farmer, be he owner or tenant, and to take little notice of the mere rent-collecting owner, and even in England, the drastic step of State ownership of all land with a system of granting land on a cultivating tenure has been proposed by land reformers.

The second set of measures comprises the restriction of imports, improvements in home marketing methods for capturing the home market, the enactment of marketing Acts, and trade agreements fixing export quotas from foreign countries. The increase in price brought about by these measures, Dr. Venn estimates at some £ 17,000,000 of increased receipts to the producer, which added to the gain from the

direct grants and remissions, brings up the total gain to agriculture to £ 40,000,000. In respect of these measures too, Dr. Venn refers to the almost revolutionary break with the age-long British tradition implied by the powers granted under the marketing Acts, whereby "co-operation" is made "compulsory". Mention is also made of the irksome red tape, supervision and interference by officialdom which one has to put up with, not to speak of the penalties and fines imposed for infraction of the Act. All this is no doubt true, but the bulk of even the latest opinion is solidly in favour of a continuation of the various subsidies (including the much-debated sugar beet subsidy), the milk 'pools' and the various other measures of State control. The nation is evidently quite willing to pay this price for the well-being of its agriculture.

There is, we cannot help noting, a strong under-current of disapproval of these measures running throughout the address which does little justice to the aims in view or the unavoidable difficulties that beset their attainment. When all is said and done, British agriculture cannot adequately feed the British people, and there was a time when hardly a quarter of her food requirements was produced within her limits and it is a well-kept war-time secret that during the winter of 1917–18 food stocks had run so low that proud and wealthy England was perilously near starvation. Such a situation, it would obviously be suicidal to allow to recur and it is not difficult to appreciate the outlook of British statesmen. To enable British agriculture to support her population out of her own resources if possible or supplement by Empire resources if necessary, is evidently the objective; to gain this end all these superhuman endeavours are being made. Dr. Venn himself testifies to the results that have already been achieved in the desired direction and this should be the justification for the vast sums being expended for the pursuit of the economic 'heresies' and the unwelcome encroachments of the State on the liberty of the individual. One wishes, on the other hand, that here, in India, our own Government would accord to Indian agriculture a suitable measure of similar support and financial help.

Conference of Delegates of Corresponding Societies.

President: PROF. P. G. H. BOSWELL, F.R.S.

THE PRESERVATION OF SITES OF SCIENTIFIC INTEREST IN TOWN AND COUNTRY PLANNING.

THE study of the regional aspects of geography is intimately connected with the consideration of the safeguarding and appropriate preservation of sites and objects of scientific, historical and archæological importance and interest in the course of town and country planning. In 1924, Prof. J. L. Myres discussed the problem of the conservation of such sites and indicated four categories of objects worthy of preservation. In pursuance of the resolution passed at the Conference of Delegates, the Council summoned a meeting, the outcome of whose deliberation was that all learned societies should take concerted steps to promote legislation wider in scope and more strictly worded than the Ancient Monuments Act. Formerly the success of efforts directed to the preservation of sites and objects of scientific interest was due to the enthusiasm of advocates and the broadmindedness and public spirit of landowners and benefactors. While this work will, it is hoped, still continue, a large share of power is now in the hands of the people, who must possess sufficient knowledge as a requisite for useful action.

How can the British Association, and in particular the Corresponding Societies, inform the people and assist them to safeguard their national memorials?

The frequent references in the public press to this and cognate subjects indicate the people's awareness of the necessity and desirability for preserving sites and objects of scientific interest. The creating of public opinion must depend upon making known such objects and the information regarding all such sites is still incomplete. So far as Botany or Zoology is concerned no systematic attempt to compile a list was ever made in any country, but by the exertions of the Geological Society, a valuable list exists. If all the learned societies could co-operate in the preparation of a complete list of sites and objects of botanical, zoological, geological, historical and archæological interest, and communicate their results to the British Association, consideration of steps to be taken to secure legislative protection, will become easy and effective.

There are two aspects of preservation which might appear conflicting. Beauty spots and magnificent sceneries must always be accessible to the public and must be preserved from the encroaches of agriculture and industries. These are nature reserves. There may be a few spots possessing both scientific and æsthetic aspects, as for instance the area surrounding Downe in Kent, and when the Town and Country Planning Act is applied to this country, there is obviously a clear case that the planning should not be allowed to obscure the scientific and æsthetic interest associated with Darwin and Lord Avebury. The British Correlating Committee for the Protection of Nature submitted in evidence before the National Park Committee in 1929, a comprehensive list of areas where nature reserves are most required. In East Anglia there are a number of scenic types not exemplified elsewhere in Britain, and the whole place is littered by sites of such geological and archæological importance that the interest in the study of Pliocene and Pleistocene geology and in the records of pre-historic man has always attracted bands of students for study and research.

It may be recalled that in 1797, the discovery of palæolithic implements from Hoxne near the country boundary of Suffolk and Norfolk led to investigations revealing the great geological and archæological interest of the succession of ancient lake-deposits and early human industries, with the result that Hoxne has proved to be unique in Britain on account of the detailed evidence that it affords of inter-glacial climatic fluctuations. Another equally interesting place is the Gipping Valley-system north-west of Ipswich which has yielded a series of sub-crag rostro-carinate implements and flakes and a succession of human industries in the succession of glacial and post-glacial deposits. The Derby Road, which disclosed an inter-glacial lake-area similar to that at Hoxne is all but lost to Science.

Professor Boswell concludes the address with a significant observation that "Our duty as trustees for the future lies clear before us if only we adopt the view, that by acting now to safeguard sites of scientific interest, we are in effect taking steps to preserve some of the very title-deeds of our intellectual possessions."

Chemotherapy of Malaria.

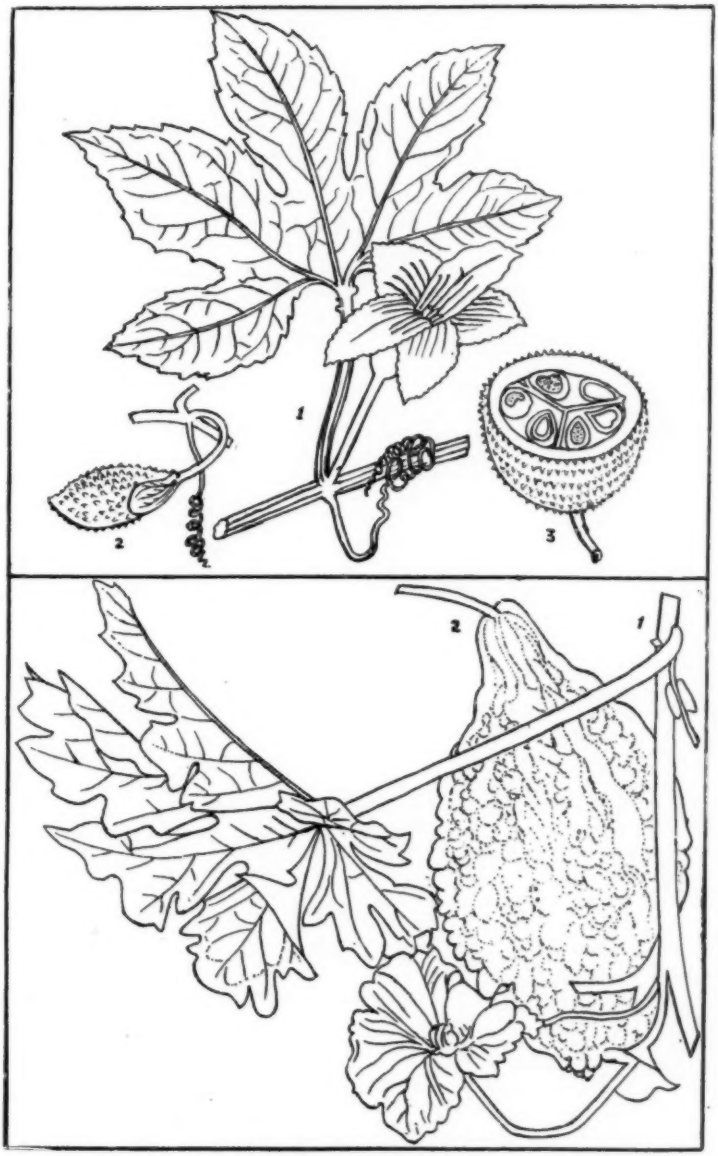
AT the recent session of the British Association, a discussion was held on the chemotherapy of malaria. Lt.-Col. S. P. James, F.R.S., in opening the discussion said, "The British Empire, with its vast malarious territories in the tropics, is more concerned with the provision of effective anti-malarial drugs than is any other nation in the world.

"Until recently the alkaloids of cinchona bark were the one and only effective remedy available. These natural products, however, are not effective for certain therapeutic purposes, particularly for true causal prophylaxis, the prevention of relapses and the prevention of spread. The aim of chemotherapy is to find preparations which will be effective for those purposes.

"Two remarkable synthetic anti-malarials, namely, plasmochin and atebrin, have been discovered and prepared on a large scale in Germany and their merits and defects for the particular purposes mentioned are now being assessed in the laboratory and in the field. Their discovery has given a great stimulus to chemotherapeutic work."

Lt.-Col. James gave an outline of methods and plans which are being tried or have been suggested for extending anti-malarial chemotherapy research in England, "where as yet it has been entirely neglected by the chemical industry and has received almost no financial assistance from Governmentor other sources."

Momordica cochinchinensis Spreng.



Momordica charantia Linn.

PLATE II.

the lime is deposited over a cellulose skeleton. This branched skeleton shows stratification of cellulose also when $CaCO_3$ is dissolved in dilute HCl (Fig. 5). As in the former species cystoliths occur in the lower epidermal cells which are much enlarged in size as usual.

In the cells of the basal hairs of *M. cochinchinensis* we also find deposit of calcium carbonate in a circular group (see Fig. 6). But here lime is not deposited on a skeletonic structure of cellulose and hence they are conveniently called pseudocystoliths. In the

other genus of Cucurbitaceæ similar deposit of lime in the leaves may be found—as for example, in the upper epidermal cells of the leaf of *Cephalandra indica* Naud, there is a considerable deposit of calcium carbonate. Such heavy deposits often impart dotted appearance on the leaf surface and give an impression of gland dotted structure (see Fig. 7). It seems that heavy quantity of lime (calcium carbonate) is deposited in these plants during the process of metabolism. According to Haberlandt[3] the deposit of calcium carbonate may be redissolved by the plant when the system demands it.

As mentioned before, lime in the form of calcium oxalate crystals is present in stems and petioles of Momordica (*M. charantia* and *M. cochinchinensis*). Most of the crystals are solitary. They are of rhombohedral types belonging to the monoclinic system (see Figs. 2, 3, 4, 6, (B), Plate I). Numerous other crystals of monoclinic system in the form of twin or clustered crystals are also deposited in the stem and petiole of these species (see Figs. 5, 8, 9, 10, (B), Plate I). Twin crystals (star-shaped) and combination of monoclinic and tetragonal system with crystals of other different structures making complex or composite forms have also been observed in the petiole of *M. charantia* (see Figs. 13, 15). Twin crystals are mostly present in the petiole, though a few may be found in the stem. The star crystals of *M. charantia* differ from those of *M. cochinchinensis* in having more projected and prominent star ends (compare Figs. 8 and 16). The crystals in *M. cochinchinensis* are less numerous and smaller in size than *M. charantia*. In both of these species the crystals are completely absent in the roots. In the stem they are more distinct and larger in dimensions. They are scattered everywhere in the ground-tissue and are absent in the epidermal cells and very scantily present in the vascular bundles.

If we trace the crystals of Momordica from the petiole to the leaf blade through the midrib we find that the size of the crystals is gradually reduced and thus the shape is not prominent, so much so that they are not distinguishable even under the higher power of a microscope, hence the term "dust crystals" are applied to them. Upto half of the midrib these crystalline dusts may be traced but beyond that they are invisible.

[3] Haberlandt, G., *Physiological Plant Anatomy*, 1924.

It is to be remembered that sufficient amount of calcium oxalate is manufactured in these plants as a product of metabolism. Prof. Haberlandt remarks that oxalic acid is formed in the plant body as the result of a variety of metabolic processes particularly in connection with protein synthesis but this substance is poisonous to the protoplasm and is accordingly rendered innocuous by combination with calcium to form the very insoluble oxalate of the metal; calcium must therefore be present in the plant in heavy quantity. According to some Plant Physiologists[4,5] calcium oxalate which is an excretory product may be redissolved by the plant when there is a deficiency of calcium food.

I am indebted to Mr. K. Biswas, Superintendent, Royal Botanic Garden, Calcutta, (Offg.), for favour of his kindly going through the paper and making valuable suggestions.

EXPLANATION OF FIGURES.

Plate I.

A. *Cystoliths from the leaf of* **Momordica charantia** (*regular shape*) *and* **M. cochinchinensis** (*irregular, heteroplanous and branched*).

FIG. 1. *Momordica charantia*—cystolith in groups of 3. × 280.

FIG. 2. *Momordica charantia*—cystolith in groups of 4. × 280.

FIG. 3. *M. cochinchinensis*—cystolith in groups of 3. × 232.

FIG. 4. *M. cochinchinensis*—cystolith in groups of 4. × 232.

FIG. 5. A double group of cystolith showing stratification of the cellulose skeleton after calcium oxalate is dissolved in dilute HCl. × 232.

FIG. 6. Pseudocystoliths in the basal cells of a hair of *M. cochinchinensis*. × 232.

FIG. 7. A calcified upper epidermal cell from the leaf of *Cephalandra indica*, the black dots indicate superficial deposit of calcium oxalate. × 232.

B. *Crystals from the leaf of* **Momordica charantia** *and* **M. cochinchinensis**. × 1000.

FIGS. 1-12 from *M. charantia*.

FIGS. 13-17 from *M. cochinchinensis*.

FIGS. 1, 5, 8, 9, 10—different forms of twin crystals (star-shaped) of *M. charantia*.

FIG. 13. Deposit of free calcium oxalate upon a crystal of tetragonal system.

FIG. 14. Formation of a star crystal on a tetragonal system.

FIG. 15. A group of crystals combined together.

FIG. 16. A star crystal from *M. cochinchinensis*; mark the difference between Figs. 8 and 16.

Plate II.

Momordica cochinchinensis **Spreng.**

FIG. 1. A flowering branch. × ½ n. size.

FIG. 2. A young fruit with a tendril. × ⅓ n. size.

FIG. 3. A T. S. of a fruit. × ¼ n. size.

Momordica charantia **Linn.**

FIG. 1. A flowering branch. × n. size.

FIG. 2. A fruit. × n. size.

[4] Dana, E. S., *Text-Book of Mineralogy*, 1905.

[5] Solereder, H., *Systematic Anatomy of the Dicotyledons*, Vols. I and II, 1908.

Chimera in Pineapple.

By I. A. Sayed, B.Ag.
Government Farm, Kumta.

A PINEAPPLE plant exhibiting the combined characters of the two varieties, *viz.*, Queen and Kew (Smooth Cayenne) grown on the Kumta Farm (North Kanara) was observed recently growing in a plot. A critical study of the same was undertaken with a view to differentiate the outstanding characters and ultimately determine its possible origin. The following are the most important distinguishing characters in which the plant was found to differ prominently from the existing two types.

The leaf margins like the Queen are armed with conspicuous spines but the surface resembles very closely the leaf surface of the Kew which has a distinct brown centre along its entire length with green edges. The leaf surface of the Queen, however, has a uniform reddish brown colour to about half the length, the base being greenish. The leaf margins of the Kew are perfectly smooth.

The tendency of the chimeric plant towards the production of 'seed' (planting material) has been found to be similar to that of the Kew which is a very shy bearer of suckers and more so of slips. The Kew variety produces on an average two suckers but instances of plant producing slips are very few and far between. The Queen pine, on the other hand, bears suckers and slips freely, often profusely; the average being four and five respectively.

The fruit and the crown consisting of cluster of leaves resemble very closely the fruit and the crown of the Kew, particularly in the colour of the 'eyes' which is deep purple. The contrast lies in the crown leaves, the margins of which are spiny like the Queen. It may be pointed out here that at the final stage of ripening of the fruit, all the 'eyes' not only showed a perceptible increase in dimensions but had completely flattened thereby giving the fruit a striking resemblance to the fruit of the Kew.

The foregoing distinguishing characters of the plant lead to the conclusion that the exposition of the plant in the present form is mainly due to the combination of characters of two distinct varieties and, therefore, it is difficult to determine its right origin.

However, the only possible explanation of this phenomenon is that the present chimera seems to have arisen from the Queen so far as vegetative characters are concerned, while the fruit gives a clear indication of its source from the Kew. And, since these have combined in a bud sport, it is reasonable to presume that the two types, *viz.*, Queen and Kew, must have arisen from a common stalk retaining the potentiality to mutate in either direction, *i.e.*, towards Queen or Kew when conditions were favourable.

Man and Woman.*

THE recent work of Havelock Ellis, *Man and Woman* which ostensibly sets forth to examine the leading characteristics of man and woman from the biological standpoint, provides an admirable background for the exposition of socio-economic problems. The fundamental point on which the main thesis is developed is that it is possible to regard the determination of sex as independent of any possible intervention by sex chromosomes, and also to recognise an essential sameness of sex in all organisms, the sexes being due to the action of two opposed sets of influences, one tending to produce the characters called female, the other tending to produce the characters called male. Apart from the physical structural differences, men and women usually display traces of dispositions belonging to the opposite sex, while it is not uncommon that the play of these traits may result in a physically homosexual condition. This conception of men and women underlies the doctrine of the entire equivalence of the sexes; and the investigation of the secondary and tertiary sex characters tends to point out that the unequal and unlike values are, in all their differences, of equivalent weight. Secondary sexual characters, supposed to be the product of sexual

*"Man and Woman". A Study of Secondary and Tertiary Sexual Characters. By Havelock Ellis. (Eighth Edition, Revised.) [William Heinmann (Medical Books) Ltd., London, 1934.] Pp. vi+469. Price 10*s.* 6*d.* net.

selection, are those obvious characters which render the sexes attractive to each other, while the tertiary characters which are not usually so obvious, and which may not be confined to only one sex, are generally predominant in one sex, such as height, stature, the structure of internal organs and the differences of endo-skeleton. There is a complete review of the anatomical features and physiological differences of man and woman, based on the conclusions deduced from scientific and statistical investigations, and the mass of information contained in the twelve chapters devoted to the treatment of the subject is simply prodigious.

The present knowledge of men and women can only tell us what they are under the influence of civilisation, but cannot tell us what they might be or what they ought to be; and even a precise knowledge of the degree of their modifiability will not enable us to limit the respective spheres of men and women. Men are more variable and women are more precocious involving greater rapidity of growth and its early arrest; these facts have consequences of wide significance. The whole physical and psychic organism of the average woman is unlike that of the average man, on account of this fact alone. Another fact of equally far-reaching character is that the average man diverges to a greater extent from the child-type than the adult woman. It may almost appear paradoxical to state that the growth of man, from about the third year onwards, is to some extent growth in degeneration and senility, through an absolutely necessary adaptation to environment, and that the human infant presents in an exaggerated form the distinctive characteristics of humanity, *viz.*, the large head and brain, the small face, the hairlessness, delicate bony system and enlarged endocrine glands. In many respects women remain somewhat nearer to children than to men, to that extent they occupy a higher scale in the line of evolution.

The facts of physical and psychical organisation of women have a profound practical bearing on the spheres of activity into which they are entering in increasing numbers. They are an important industrial factor, although a large portion of them may not remain as life-workers. Apparently, as a sex, they seem to lack both a man's ambition and his disinterested mental curiosity. Because of the possible transitoriness of their engagements, it is difficult to estimate the force and soundness of their disposition to be trained for skilled and responsible positions. At present, it is only in Scandinavia that women as a sex seem to be demonstrating any aptitude for the more skilled branches of technical work and obtain employment on equal terms with men. This is largely due to the fact that the economy of reproduction under improved conditions has given greater freedom to women and conferred on them a greater control of their own energies. The activities of men and women in all gainful occupations are bound to become competitive and their harmonious and wholesome relationship must depend in all such adaptations upon the preservation of the fundamental and natural constitution of each sex. The doctrine of the equality of the sexes led to unregulated industrialism, with consequences most injurious to women as is reflected in the condition of the physical and mental health of women labourers.

It seems fairly certain that women are not going to outstrip men or even to equal them, in the fields in which men are certainly successful. It is only in one country that they seem to be rising to the most responsible type of position and that country presents conditions both unusual and abnormal—Russia.

We have read this book with great pleasure. The interest of the book extends far beyond the limits of biological implications of sex. The study of secondary and tertiary sexual characters opens a new field of investigation of the social and economic problems, and their readjustment and final solution should not be subordinated to political doctrines.

The book is a profound philosophical treatise on the most fundamental human problem in its varied and complex aspects, and the clarity of vision, scholarship and above all the total absence of prejudice and conventional formulas which distinguish its pages are a contrast to the common-place literature on the subject of sex. Havelock Ellis is a wise thinker and his outlook may even be conservative, but his contributions to contemporary thought on psycho-physical subjects are marked by deep sympathy and wise scholarship. His *Man and Woman* is undoubtedly a great work and students of Anthropology, Sociology, Economics and Politics will find in it a wealth of information such as few books can provide.

Research Notes.

The Zeroes of the Riemann Zeta-Function.

RIEMANN conjectured that all the complex zeroes of $\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s}$ where $s = \sigma + i\,t$ lie on the line $\sigma = \frac{1}{2}$. No one has proved, till now, that the above famous conjecture is either correct or false. Extensive calculations of numerical kind have, however, shown that the conjecture is true for t lying between 0 and 300 and that the function has 138 zeroes in the above interval. Recently, Dr. E. C. Titchmarsh [*Proc. Roy. Soc.* (*A*), 1935, **151**, 234] has extended the numerical calculations by developing suitable formulæ and has found that the Riemann conjecture is true for t lying between 0 and 390 and that all the zeroes in the above interval, 195 in number, lie on the critical line $\sigma = \frac{1}{2}$. He has also presented some theoretical considerations on the problem of the zeroes.

N. S. N.

Combined Influence of Electric and Magnetic Fields on the Line Spectrum of Helium.

THE effect of crossed electric and magnetic fields on the line spectrum of Helium observed by W. Steubing (*Sitzb. d. kgl. Preuss. Akad. d. Wiss.*, 1935, pp. 1–16) has already been described in these columns (*Curr. Sci.*, 1935, **4**, 114). We may now notice the effect of coaxial electric and magnetic fields. There are a number of alterations in this case also, but the broadening of the Stark effect components does not occur. The Zeeman effect and an alteration of the intensities of the Stark components are observed.

I. Doublet separation is found only in s-components while the p-components (see III however) remain sharp and unaltered.

II. The sharp series shows a sharp Zeeman effect. The principal series is midway between the sharp and diffuse series in its behaviour.

III. In the diffuse series we have the null component (p and s) due to the magnetic field as a new line in place of the intense Stark effect pattern, and here the s-component becomes a doublet. The actual Stark components are present in the higher series members with low intensity, but their positions and relative intensities are as in the normal Stark effect, but the s-components all become double. The combination lines produced by the electric field vanish.

IV. With an electric field of 45,000 v./cm. and a magnetic field of 20,000 Oersted only the strongest Stark components of the diffuse series are faintly present. But with a magnetic field of 10,000 Oersted, the null line, which is very strong in the above case, vanishes while the normal Stark effect components are present.

The alterations in intensity are less important than in the case of crossed fields.

T. S. S.

The Relation between Atomic and Cosmic Constants in the Expanding Universe.

IT is now well known how Eddington has tried to bring about a relation between the dimensions of the atom and of the Universe in his theory of the fine structure constant. H. Ertel in the *Sitzb. d. Preuss. Akad. d. Wiss.*, 1935, deduces a relation between Einstein's cosmological constant λ, Newton's gravitation constant denoted by the author by the letter f, the proton mass m_+, the electron mass m, which is as follows:—

$$\frac{f\,m_+^{\,2}\,mc}{\pi he^2} = \pm\sqrt{\lambda}$$

where c is the velocity of light, h is Planck's constant and e is the electronic charge. This result is deduced from Einstein's cosmological field equations and Friedman's differential equations which represent Lemaitre's theory of the Expanding Universe, together with a generalization of an equation given by Eddington.

If l_p and l_e are the de Broglie wavelengths of the proton and the electron ($=\frac{h}{m_+c}$ and $\frac{h}{mc}$) respectively, the above equation can be written in the more symmetric form

$$f\,\frac{m_+ m}{e^2} = \pm\,\pi l_p\sqrt{\lambda}$$

$$f\,\frac{m_+^{\,2}}{e^2} = \pm\,\pi l_e\sqrt{\lambda}$$

With the numerical values $h = 6{\cdot}547\times10^{-27}$ erg sec., $c = 2{\cdot}998\times10^{10}$ cm./sec., $e = 4{\cdot}770\times10^{-10}$ e.s.u., $m = 9{\cdot}00\times10^{-28}$ grm. $m_+ = 1{\cdot}662\times10^{-24}$ grm., $m_+/m = 1847$ and $f = 6{\cdot}65\times10^{-8}$ dyne cm².⁄grm.², $\frac{1}{R}\frac{dR}{dt} = a$ (the Hubble factor) is calculated on the basis of the above theory to be $1{\cdot}812\times10^{-17}$ sec.$^{-1}$ while the experimental value is $1{\cdot}811\times10^{-17}$

sec.$^{-1}$ with an uncertainty of 20%. a is connected with λ by the equation

$$\frac{1}{R_0^2} + \left(\frac{a_0}{c}\right)^2 = \lambda = 3\left(\frac{a_\infty}{c}\right)^2$$

where R_0 = the equilibrium radius of the Universe and a_0 and a_∞ are the values of a for R tending to 0 and ∞. The theory gives $a_0 = 1 \cdot 134 \times 10^{-17}$ sec.$^{-1}$ and $a_\infty = 1 \cdot 833 \times 10^{-17}$ sec.$^{-1}$.

T. S. S.

Passivity of Gold.

THE resistance of gold to ordinary reagents and atmospheric influences has been traced to the formation of an adherent film of oxide on its surface. On the other hand, the anodic passivity of gold has been a matter of some controversy. Müller and Löw (*Trans. Far. Soc.*, 1935, **31**, 1291) have extended their "Surface Layer Theory" (Bedeckungstheorie) of passivity for gold electrodes. They have examined gold electrodes, under a reflection-polarisation microscope, when subjected to electrolysis in hydrochloric acid, taking care to protect the electrodes from convection currents. Simultaneous measurements of the current density have also been made. The surface at first appears dark under crossed nicols, and after a certain interval of time during which the current passes, it becomes bright. Corresponding to this latter stage when the current density falls, a diffuse layer of crystalline deposit is observed. The results show that gold exposed to air becomes coated with an oxide layer which is removed during anodic passivation in concentrated hydrochloric acid. An adherent film of the metallic salt now takes the place of the oxide layer. Discharge of OH^- ions at the anode can give rise to a 'secondary' oxide film. When the solution is well stirred the film of the metallic salt is easily disturbed. The natural oxide coating on gold is very stable and dissolves only in strong (5N) hydrochloric acid. The 'secondary' layer produced during anodic passivation is much less stable and disappears quickly even in dilute acids. In 5N hydrochloric acid, the 'secondary' layer formed, is dissolved out even during the passage of the current. The oscillations in current density when electrolysis is carried out are due to the alternate formation and dissolution of the film. The work of Müller and his co-worker brings out the close analogy between the behaviour of gold and of other metals less 'noble'.

M. P. V.

The Effect of Magnesium Deficiency on Crop Plants.

THE response of various crops to a deficiency of magnesium in the soil is described as the result of experiments conducted at the Massachusetts Agricultural Experimental Station by A. B. Beaumont and M. E. Snell (*J. Agri. Res.*, 1935, **50**, No. 6). Plants sensitive to magnesium deficiency developed characteristic physiological symptoms which have value in diagnosis. Chlorosis of the older leaves developed in the intravascular tissue. In the leaves with parallel veins this produced a striped appearance while in plants with a netted venation, a mottled pattern was produced. Curling of the leaf margins and marked necrotic areas also appeared in certain plants. Buckwheat and spinach were most affected, and turnips, mangels, corn and tobacco considerably so. The small grains, grasses, clovers and potatoes were only slightly affected. The addition of magnesium sulphate to the soil increased the percentage of magnesium in the plant or portions of it, the increase being greatest in the plants which were most affected in yield or appearance by a magnesium deficiency. It appears that to avoid magnesium deficiency a soil should contain from 30 to 40 parts per million of easily replaceable magnesium or 60 to 80 pounds per acre.

A. K. Y.

Pollination Studies in Toria and Sarson.

CROP improvement work relating to the two most important oil seeds of the Punjab *viz.*, Toria (*Brassica napus* L. var. Dichotoma Prain), and Sarson (*Brassica campestris* L. var. Sarson Prain) with particular reference to the special features of their pollination undertaken at the Lyallpur Agricultural College by Ali Muhammad is described (*Indian J. of Agr. Res.*, 1935, **5**, Part II). In both crops, cross fertilisation appears to be the usual method in nature chiefly through insect agency. Attempts at selfing under bags yield very poor results; in the six years' trials on the average only 12·3 and 20·3 per cent. respectively formed pods and many of these were not normally developed. The high self-sterility is surmised to be due not to external causes alone but internal causes also such as self-incompatibility. The explanation is suggested that the self-pollen is subject to an inhibiting action by the stylar tissue which makes it of slower growth than foreign pollen. The

observations also indicate that the inhibiting action is not equally effective in flowers of different ages, the secretion responsible for the action being produced actively between one to two days before and after flowering. Inbreeding and pure lines being thus of no economic value, group breeding has been resorted to and considerable improvement is reported to have been achieved already by mass-selection. It is stated as the result of hybridisation studies that self-fertility behaves as an inhibited character independent of the colour of the seed and that self-compatible brown seed plants have been evolved.

A. K. Y.

Spiral Structure of Chromosomes.

In three papers of the July number of the *Proceedings of the Royal Society*, London, C. D. Darlington has described the detailed spiral structure of chromosomes in the several species of Fritillaria, and has deduced certain generalisations regarding the internal mechanics of chromosomes. The first paper [*Proc. Roy. Soc. Lond.*, (B), No. 807, 33], may be regarded as the general part where the broad features of spiral structure are described. The meiotic chromosomes possess both the major and the minor spirals and the first meiotic telophase, the major spirals relax to form relic spirals and by further expanding their loops form superspirals. The minor spiral does not relax. In the ensuing prophase the chromosomes contract and the relic and super-spirals disappear. The second metaphase chromosomes show similar spiral structures. During somatic mitosis only the minor spirals are present. The metaphase chromosomes show the threads very compactly coiled, while during the resting stage and during the later stage the threads divide. The nuclear cycle in mitosis shows that older coils are generally uncoiled externally while new coils are formed internally. In this respect prophase is a continuation of telophase and not a reversal of it as is usually supposed. The usual interpretation of the split nature of the metaphase and telophase chromonema are regarded as inconsistent with the spiral structure and with genetic and cytogenetic data. Several general assumptions have been made the chief of which are that the spiral arrangement is determined by a compensating molecular change, that there is a hysteresis or lag in the adjustment of the external form of the chromosomes to its internal molecular stresses and that paired chromosomes and chromatids on this account develop a " relational coiling ".

In the second paper [*Proc. Roy. Soc. Lond.*, (B), No. 807, 59] a special study of the meiotic pairing in Fritillaria has been made. Pairing in this genus is incomplete and is liable to fail in parts attached to the nucleolus and the unpaired parts become relationally coiled. In fifteen species, pairing is interrupted very early and is therefore confined to the proximal regions. This leads to the localisation of chiasmata. The interruption of pairing is presumed to be due to the division of unpaired parts.

In the third paper [*Proc. Roy. Soc. Lond.*, (B), No. 807, 74] the relationship between chiasmata and the relational spiral is dealt with in detail. Three species of Fritillaria, *F. Elwesii* with intermediate localisation, *F. Meleagris* with extreme localisation, and *F. imperialis* with free distribution, have been studied. In the first two species the pairing is incomplete while in the last one it is nearly complete. Chromosomes remain associated at diplotene stages by chiasmata in the paired regions and by relational coiling in the intercalary unpaired regions. This can be understood if it is presumed that coiling occurs throughout the chromosomes but is replaced by chiasmata in the paired regions. In most organisms this replacement is nearly complete, but in diploid organisms with localised chiasmata and in triploids, coiling survives.

Dominance in Poultry.

A PRELIMINARY report of experiments of R. A. Fisher intended to throw light on the nature of dominance observed in certain well-marked breed characteristics in domestic poultry has recently been published [*Phil. Trans. Roy. Soc.*, 1935, **225** (B), 195]. The paper gives detailed data for the three factors responsible for crest, polydactyly and barred plumage.

The belief of Darwin and earlier writers that hernia was connected with the crest was abandoned by geneticists early in the 20th century on inadequate evidence but from his experimental data he has been able to conform completely with the view that crest and hernia are due to the same gene. This view also explains other significant features in the data; notably the complete absence of grown birds showing hernia without crest and the linkage relations with the Polish comb and with Pile.

Polydactyly when introduced into the wild jungle fowl is a typical example of the mutations with intermediate heterozygotes in which dominance is absent. The heterozygote is distinctly variable and occasionally overlaps the normal homozygote.

Barred plumage is more nearly a recessive than a dominant mutation; the heterozygous males are more like the wild than like the barred homozygotes. The barred hen when young is indistinguishable from the heterozygous male. The barred mutation thus introduces a sexual differentiation and when this sexual differentiation does not exist barred may be described as a dominant.

The three factors reported in this paper bear out the suggestions that the supposed "dominants" found in domesticated breeds of poultry show distinct lack of dominance when introduced singly into a wild strain. Any dominance shown by them in breed crosses must be due to modification during the period of domestication.

The Development of the Vertebral Column in the Haddock (*Gadus æglifinus*),

IN this contribution to our knowledge, a set of new observations is made on the vertebral column of the Haddock by A. J. Faruqi (*Proc. Zool. Soc. Lond.*, Part II, 1935, 21). The perichordal sheath forms the centrum of the vertebra in *Gadus* unlike in *Herring* where the notochordal sheath participates in it. The basi-occipital region is a composite structure incorporating in it an 'intercalary' neural arch. As opposed to the tetrapoda, the posterior zygapophyses take their origin from the centrum itself. Confirming the observations of Stannius, it is noted that the spinal ganglia in the trunk region become divided into two,—an upper accessory ganglion and a lower spinal ganglion and these two are connected together by a commissure.

On the Post-Embryonic Development of the Respiratory System of *Dialeurodes dissimilis* (*Homoptera, Aleurodidæ*).

BESIDES Fuller's pioneer work on the post-embryonal development of the tracheal system of termites, not much work has been done on this important problem. M. L. Roonwal gives us an account of the post-embryonic development of respiratory system in *Dialeurodes* (*Quart. J. Micr. Sci.*, 1935, **77**, Part IV, 605). The author points out that the number of spiracles in the nymphal instars is 4 and the tracheal system consists of paired ventral- and dorsal-longitudinal trunks. Tree-like branches arise some of which of course atrophy,—the final number being 156.

Larval Stages of Trilobites from the Middle Cambrian of Alabama.

C. G. LALICKER'S (*Jour. of Palæo.*, **9**, No. 5) observations on the Trilobite Fossils from Alabama show a series of changes in the larvæ specially in the "protaspis stage" not noticed hitherto—the most important being the appearance of eyes later than the facial suture, palpebral lobes and free cheeks on the dorsal side—instead of migrating from over the margin from the ventral side, as formerly suggested. This "spontaneous generation" of the eyes on the free cheeks seems to develop during some critical moult which takes place in some trilobites earlier than in others. Secondly, the migration of free cheeks from an early anterior position to a late lateral position indicates that during the protaspid stages the cephalon is of the proparial type, whereas it becomes opisthoparial in the meraspid and holaspid periods. These observations suggest that the appearance of eyes in a later stage was in the nature of an "adaptational control" as a result of the existence of both larvæ and adults under aphotic or nearly aphotic conditions.

C. P. K.

Paleozoic Foraminifera, their Relationships to Modern Faunas and to their Environment.

OUR knowledge about paleozoic foraminifera was usually confined to the study of fusulinids. Improved technique and intensive collection in recent times have revealed a large foraminiferal fauna throughout the paleozoic. The development of the group indicates that the earliest types had chitinous tests. During the next stage there was attachment of various foreign particles to the chitinous test. The upper cambrian form—Spirillina—indicates that the earliest foraminifera were tubular and consisted of an early proloculum. Later on the foraminifera developed an elongate undivided chamber often coiled about itself in one plane. Foraminifera with calcareous tests have not been reported till carboniferous times and this suggests that the primitive forms were predominantly arenaceous. At present the arenaceous forms occur in various habitats but most commonly in waters of

medium depth in temperate regions. In waters where calcareous materials are abundant, the chitinous cement which would hold the foreign particles on the test would be converted to calcareous substance thus giving rise to calcareous tests. From these observations J. A. Cushman (*Jour. of Palæo.*, **9**, No. 3) suggests that calcareous foraminifera developed later and had a limited habitat.

C. P. K.

The Yeravas of Coorg.

By Rao Bahadur L. K. Ananta Krishna Iyer.

Introduction.—The *Yeravas* are the aborigines of Wynad, one of the taluks of South Malabar, from which they gradually spread to the forests of South Coorg. They are rarely found in the northern division. They are the lowest of the jungle tribes of Coorg. They appear to have been, from a remote period, in a servile relation to the *Betta* Kurumbas. They are now scattered all over the villages of the two *Nads* of Ponnampet and Srimangala.

Internal Structure of the Tribe and Habitat.—There are four endogamous groups, *viz.*, the *Panjiri*, the *Pania*, the *Badava*, and the *Kagi* Yeravas or *Karatte*. The *Panjiri* stand highest in the social scale, and the *Kagi*, the lowest, because of their habit of eating crows (*Kan Kagi*). The *Panjiri* Yeravas are divided into two subgroups, *viz.*, *Ippumale* Yeravas and *Karatti* Yeravas. The former are said to have immigrated from *Ippumale*, which is situated beyond the Manantoddi river; and are generally found in Srimangala and Ponnampet Nads; and the latter in *Karattimale*, near Bythor. Though they belong to one and the same group, yet there is no intermarriage between them. *Panjiri* Yeravas have come from Mysore. The *Badava* Yeravas who are mostly found in Mysore near Heggadadevanakote, are rarely met with in Coorg. There is no interdining and intermarriage between these two classes. There is also not much difference between the *Pania* and *Karatti* on the one side, *Panjiri* and *Badava* on the other. The *Panias* and *Panjiries* neither interdine nor intermarry. A *Panjiri* can become a *Pania* but not *vice versa*.

Habitations.—The Yeravas live in thatched huts. The walls are made of bamboo reapers, interwoven and plastered with mud. They never build a house with mud walls because of their migratory habits. Frequently they run away without provocation from their old masters to some distant places in the forest and on settling down under another landlord, they proceed to build a fresh hut. Their dwelling places generally have a veranda of about 10 feet square. Walls are half built all round. Their fire-place is on one side. They have a small pit to pound paddy in. Their domestic vessels are mostly earthen pots and dishes. The latter are used for taking food. They rarely use copper or brass vessels. Before the occupation of a newly built house, the Yerava worships *Kuttathamma*, their chief deity and *Gulikan* (a demon) with offerings of rice, cocoanut, toddy, banana and fowl, with the prayer, "O! Ye Divine Beings, by your grace we have built this hut; keep watch and ward over us and our family."

Betrothal.—Cross-cousin marriage is in vogue amongst them. The Yeravas avoid all relations on the father and the mother's side. The Yerava adults have no voice in the choice of a maid for wife. It is generally their parents who negotiate for the marriage of their sons. When a young man has reached the marriageable age, and a suitable girl is found, his parents and the headman of the tribe* (*Kanalādi*) take the *tāli* or marriage badge, a *sādi*, and all the articles necessary for their food to the hut of the bride-elect. They prepare the food, light an oil lamp filled with cocoanut oil and offer sacrifice to their gods, *Kuttathamma* and *Gulikan* along with cocoanut and banana. Some rice also is placed in a sieve. The maid's *Kanalādi* asks them the object of their visit. The young man's *Kanalādi* replies that they have come to propose the marriage of their daughter to the young man. The girl and the young man's names are also given. Then, the bride's *Kanalādi* says in the presence of the gods and those assembled, that they are prepared to give the maid in marriage to the young man. She is brought to the presence of the parties assembled. They then pray to their gods to help them in the celebration of the marriage. The *Kanalādi* of the bridegroom-elect ties the *tāli* round the girl's neck, and gives the *sādi* to her with one *hana* (three annas). The parties sit together and partake of the food already cooked. The maid's *Kanalādi* fixes the date of marriage (*Mangala Kurippu*). Generally the betrothal takes place a month before the marriage, to the celebration of which the *Kanalādis* on both sides must consent. If the bride's party cancels the betrothal, they have to pay the expenditure incurred by the parents of the bridegroom-elect. If the fault is due to the indifference or neglect of the bridegroom's party they should forfeit everything given to the bride-elect.

Marriage Ceremonies.—On an auspicious day before the celebration of the marriage, the relatives of the bride and bridegroom assemble in the respective families. *Chapras* are erected with ten or twelve poles in front of the houses of both the bride and bridegroom. Pigs or fowls are slaughtered. Ancestors are worshipped. Parties assembled are treated to a feast. The night is spent merrily by the beat of drum and the tuning of pipes for dancing. On the day of marriage the young man is bathed, neatly dressed and adorned, and is conducted to the marriage in procession. He is seated on a tripod a foot high. A lamp is lit before him. His mother and other married women throw rice on him as a token of blessings, and give him a present of a few

*The name *Kanalādi* in Wynad and Coorg is applied to a class of men who act as "Oracles", "Fire-walkers" and "Devil-dancers".

annas. Then follow others, after which the members assembled there are sumptuously entertained. In the evening the bridegroom's party start in procession to the family of the bride-elect so as to reach it before day-break. They halt near the residence of the bride-elect. The bride's party welcome them with light refreshments and toddy. They are conducted to the marriage booth in front of the hut of the bride-elect. As the bridegroom-elect enters the booth, an elderly woman of the family washes his feet, for which one hana is paid to her service. He is then seated on a tripod. All the gods of both parties are served with parched rice, cocoanut and bananas. The bride and bridegroom are asked to stand together, and the gods are invoked to witness the ceremony and to bless them when the assembled guests throw rice and give them presents, varying from three pies to three annas. The *Kanalādi* asks the bridegroom to grasp the hand of the bride. The guests assembled there are treated to a feast, after which the bridegroom and his party with the bride return to his hut. Just then the bride's mother or some elderly woman stands at the gate, when the bridegroom gives her eight annas and requests her permission to take the girl. In the family of the bridegroom the same formalities are gone through. The bride touches the feet of everybody as a sign of obedience and respect to the elderly members who give some presents of coins which become her pocket-money. The *Kanalādi* comes on the fourth day. The bride is bathed, dressed and adorned in her best. She performs the *Gangapuja* and brings water to the hut in a few pots. She is then dressed in a new *sādi*. After a sumptuous meal the guests disperse. There is no special ceremony for consummation which takes place in the bridegroom's hut after his return with the bride. The married couple again go to the bride's family, stay there for a few days and then with the bride return home. Thereafter they live as husband and wife.

If the parents are unable to meet the expense of the ceremony, they connive at the young persons making friends, and the girl one day elopes with the young man, and remains in the forest for a few days, and then the girl returns to her hut. She is not allowed to enter it. Her parents inform the villagers who assemble to enquire into the matter. The *Kanalādi* comes. The couple confess their guilt, and pay a fine of a rupee or two, when they are condoned. The *tāli*-tying takes place. They become husband and wife. These formalities cost five rupees, while the marriage ceremony requires twenty-five rupees. A man can have more than one wife. The first wife has no special privileges. Concubinage is also allowed. Widow marriage is in vogue amongst them. On the day fixed for the marriage ceremony the man goes to her hut with his friends and relatives, invokes his gods for blessings, and ties a *tāli* round her neck, and gives her three annas. Thereafter they become husband and wife.

Adultery and Divorce.—Adultery and divorce are current among them. When a woman commits adultery with a man, and when that is known, a meeting of the tribesmen is called for to enquire into the matter. When it is proved the delinquent has to pay a fine of one to ten rupees. Sometimes he is compelled to marry her after payment of the marriage expenses for which he is responsible. A man can divorce his wife at his will and pleasure, when he simply takes her to her parents and says that he does not want her. This is the ordinary form of procedure. Sometimes the husband in a fit of provocation sends her out of the house, saying that he does not want her, and that she can go where she likes.

Pregnancy.—When a woman is pregnant her parents visit her during the seventh month, give her sweets and stay with her for a day or two, and then take her to their hut.

Delivery and Child-birth.—The Yeravas put up a temporary hut for the delivery and confinement of their women. When a woman suffers from pains of child-birth an elderly woman of the family—usually her mother—acts as her nurse. Soon after delivery, the mother and the baby are bathed in warm water, and this is continued during the period of uncleanliness. Soon after delivery, she is given a decoction of cumin seeds, ginger, asafœtida, and fed with rice *kanji*. The pollution is for eleven days and she bathes on the twelfth, when the naming, feeding, and cradling formalities are gone through. She continues to be in a state of uncleanliness for a period of forty days.

Family.—Family is patriarchal. In the absence of children to a man, he can adopt a boy, below twelve years of age. The *Kanalādi* comes and the boy is bathed and dressed in new clothes. Their gods are worshipped with offerings of rice puddings, cocoanuts and bananas. The *Kanalādi* holds the boy's hands and says that henceforth he is the son of so and so; "let the gods who are invoked bear witness". He hands over the boy to the person who adopts.

Every adult member of the family should work and earn his daily bread, unless he or she is sick, old and infirm. Not even one per cent. of the Yerava population owns lands. They are all coolies. An Yerava will preserve nothing for the morrow. He wants everything fresh. The family—both husband and wife—goes to work, and each member gets food and paddy as wages. They bring the paddy, and the woman pounds only as much of the paddy as the family requires for the night's consumption. The man will sit near the fire or in the moonlight during the dry weather beating his drum and singing. The boys and girls dance, sometimes the woman also joins the dancing party. At the time of the harvest and on full moon days the drumming and dancing will last throughout the night. They never use a lamp in their huts. Often a Yerava feels reluctant to work. He does not care for the urgency of his master. He will quietly walk with his wife into the jungles in search of honey, fruits, roots or fish. Generally the wife cooks the food. But there is no objection if the husband joins her.

Tribal Organisation.—The villagers assemble together at a certain place once in a year, the main object of which is to offer prayers with sacrifice to the spirit of the dead. The meeting continues for three days. Every family has to bring rice, cocoanut, toddy, etc. First they enquire into and discuss about cases of adultery, divorce, elopement, etc., if any. The *Kanalādi* presides and decides such cases. Then the deities and the names of the dead are propitiated with rice

puddings, cocoanut, toddy and fowl. The *Kanalādi* performs the rites, sings songs in praise of the sanity and powers of the tribal deities *Kuttathamma*, *Gulikan*, *Kuttichathan*, and the dead heroes who have done great deeds such as killing tiger, driving away demons and other spirits. When this is over they eat and make merry. The Yeravas have their own pipes and drums, and bring as many sets as they can afford. Young men, women and children join together and dance in a circle to the piping and beating of drums. This continues day and night. It is chiefly in this "*Pandalata*" that women (other's wives) and grown-up girls are enticed away by men. They quietly slip away at night and seek their abodes in the forest for some days or go away to distant villages where they live as man and wife. Those who escape into the forest return in a day or two. The *Kanalādi* fines them, compensates the husband of the woman by payment of a few rupees. If the fine is not paid, the culprits will be expelled. Nobody dares to go against the judgment of the *Kanalādi*. His post is hereditary.

Sorcery and Witchcraft.—They believe in magic, sorcery and witchcraft like the jungle tribes. Spirits and Gods are believed to enter into the body of *Kanalādi* or some other person appointed by him. The spirit or the God will speak through the man, give information of the past and prophesy. They believe in the potency of evil eye. All kinds of disease are brought about by the evil spirits or demons, and the gods of the *Panchamas* to obviate which talismans, enchanted threads and certain beads are worn by them.

They practise sorcery. The sorcerer draws the picture of a demon with rice powder and to make it appear fearful to look at, he puts powders, coloured red and black, here and there, and keeps cocoanut oil lamps. Bamboo sticks about a cubit long are sharpened at one end pointed like a pencil. Clean cloth is tied at one end, and then it is dipped in the oil and lit. This is the lamp used on such occasions. Beaten rice, etc., on plantain leaves is kept at one side. The sick man is made to sit before the leaves. The sorcerer with coloured water in his hand begins to utter his incantations and finally kills a fowl, after sprinkling the water on it.

In case of exorcism by dance the sick man is made to sit in the centre, and is decorated with flowers and *kunkum*. The sorcerer and his subordinates beat their drums and dance round the man singing peculiar songs. Sometimes the sick man if he is believed to have been possessed by a spirit, is beaten with a cane. He then runs; the sorcerer takes him to a tank or river and makes him dive and come out. He (sorcerer) gives him new clothes to wear. The spirit is then supposed to have left him by this time.

Religion.—Their gods are *Kuttathamma* and *Kali* who are believed to reside in a place near Kutta, a small town between Coorg and Malabar. *Chāmundi* and *Kāveri Amma* are their chief deities.

The routine form of worship is as follows.—The *Kanalādi* keeps rice, cocoanut, etc., in a neat place, lights a cocoanut or a castor oil lamp and stands before it, facing the sun, and prays to God, requesting Him to grant what the worshippers want. They keep no image, but plant a rough stone under a tree to represent their *Gulikan*. At Kutta their chief Goddess *Karingali* or *Kuttathamma* is represented by a stone. They offer toddy, a fowl or two with prayers when they worship. They worship *Ganga* (water goddess) during marriage ceremonies. They observe all the Coorg festivals and those of the high class Hindus, namely,

1. *Makara Sankramana* in January.
2. *Sivaratri* in February.
3. *Gowri* and *Ganesa* in September.
4. *Kalimuhurta* in September (Coorg festival).
5. *Kaveri Sankramana* in October.
6. *Hutri* in November or December.

The Yeravas have a *Karingali* mutt in Wynad. Some go there as pilgrims. They fast during *Kuttathamma* festival in February. This festival lasts for seven days. They do not worship rocks or trees, but plant rough stones under a tree to represent their gods and demons.

The fields are believed to be haunted by devils, for which they offer sacrifice. The *Kanalādi* comes to Kutta during the *Karingali* festival. He is the final authority on all religious disputes and on matters connected therewith.

The Yeravas worship the Mother Earth, the river Cauvery, *Lakshmanathirtha* and other springs. Before commencing to dig a well they consult their priest and sometimes they sacrifice fowls and offer cocoanuts.

Funeral Customs.—The dead are generally buried. The dead body is washed and covered with a new white cloth. It is then covered with earth. Some rice and milk or if milk is not available, cocoanut water are poured into the pit. Some rice and water are also placed close by. On the eighth or tenth day the funeral ceremony is performed. They call it *Kake Pile* (bali) and keep food for the crows. The hut is smeared with cow dung. All bathe. The *Karanavans*—all the dead—are offered food, meat and toddy. The *Kanalādi* calls upon the God and the Sun to give a good place to the spirit of the dead, and protect the living members of the family. The closest relations keep the offerings outside the hut for the departed soul. If crows do not eat it at once, the members of the family think that there has been something wrong, and also infer that gods and the departed souls are angry with them. Often they perform the ceremony again on another day.

Occupation.—The chief occupation of the Yeravas is agriculture. They have no lands of their own, but work for wages. They select auspicious days for ploughing, sowing seeds, transplanting and reaping. They also know which rain is the best one for each crop, and some foretell by the commencement of the rain, the year's crop. They perform no ceremonies either at the beginning or at the end of the agricultural operations. But like other agricultural communities they worship the implements, bullocks and the like.

Prædial Slavery.—Prædial slavery in Coorg differed only in a few respects from that in the districts below the ghats. The members here were condemned to this state of servitude and were in a complete state of degradation. They belonged to three classes, one below the other; and all belonged to the lowest grade of society. Three to five members were owned by a proprietor of a small estate. Though they were not treated with severity, the general conditions of their

service subjected them to great hardships. They were rarely sold, but were frequently given as security for the money borrowed. This was the most general mode of transferring the usufruct, and one, above all others, likely to produce the greatest wretchedness. The mortgagee had the benefit of their services for the time being, and this was considered as equivalent to the interest for the sum advanced. They are now free. The state of prædial slavery here described is to some extent similar to that of the rural vassalage yet known in Poland and parts of Russia.

The prædial servants of the agriculturists were obliged to perform the work of the Circar. The servants of every ryot were at the disposal of the Circar, and their service given as a matter of right which was generally admitted. Each cultivator had to supply a certain number in proportion to his means, and the *Parpully* of the *Nad* was entrusted with all arrangements regarding them. Each Nad had to furnish a certain number of labourers for work. This requisition extended also to the Nads below the ghats. The body of labourers thus always collected was generally employed at the Capital, (Mercara), where works of some kind or other were constantly undertaken. No compensation was given to the owners of the servants thus employed; because it was termed *Kuhee* or voluntary, and consequently the servants got no wages. They were fed by the Circar during the period of work. This system pressed hard on both masters and servants, particularly the latter, who felt and considered it a serious evil. There were numerous other instances in which labour was supplied to the Government without any remuneration.

Social Status.—The Yeravas avoid the food cooked or touched by the Muhammadans, Panchamas and others who eat beef. They eat food cooked by the members of the other castes.

Appearance, Dress and Ornaments.—The Yeravas are diminutive in stature. Their complexion is dark, and their whole appearance carries with it an air of wretchedness. Their garments consist of a loin cloth, and they wear no head gear. The hair is tied into a knot on the top of the head, which gives them a wild and savage aspect. Those who have observed them confirm that they possess the Negroid characteristics with thick lips and compressed nose, though both features have been considerably effaced. Their curly hair is very much softened by combing.

Conclusion.—The Yeravas have very much improved of late. Both men and women are hard working, and they are therefore in great demand in coffee estates. They are not reliable, and the contact with estate coolies and maistries has spoilt their simple habits and made them adepts in cunning and cheating. They often decamp from their bamboo huts in the jungle, and travel with kin unobserved in one night out of reach of the pursuer. They often run away with advances, and extend their wanderings to Wynad, and on their return they easily find new masters with little or no chance of discovery especially when employed in Coorg houses during the working season. They conform as much as practicable to the mode of life and worship of the Coorgs. Like the Kurumbas they are chiefly found in Kiggatnad and Yedalknad taluks.

Science Notes.

Some Observations on the Thermal Structure of Cumuliform Cloud:—R. G. Veryard (Indian Meteorological Department, Scientific Notes, Vol. VI, No. 61).—During 1932 and 1933, a number of observations were made at Peshawar, Kohat and Risalpur, in the N. W. F. P., of the temperatures (dry and wet bulb) inside and outside cumulus and cumuliform clouds. Although the readings cannot be accepted as reliable to within less than 1°F., they are interesting inasmuch as they confirm that the temperature inside cumuliform cloud may be higher or lower than the temperature of the surrounding air. An analysis of the results shows that (*a*) on thirteen out of the fourteen occasions when the cloud was observed to be dissolving, its temperature was mainly lower than that of the surrounding air, and (*b*) out of twenty occasions when the cloud was observed to be growing, its temperature was mainly higher than that of the surrounding air on ten occasions but mainly lower on six occasions. With regard to the question of supersaturation, the observations do not show convincingly that supersaturation occurs in cumuliform cloud.

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The Geological, Mining and Metallurgical Society of India.—At the 10th annual meeting held in August, the following were elected members of the Council for 1935-36:—

President: Prof. N. P. Gandhi. *Vice-Presidents*: Mr. P. Evans and Mr. J. K. Dholakia. *Joint Secretaries*: Mr. N. N. Chatterjee and Prof. S. K. Bose. *Treasurer*: Mr. S. L. Biswas. *Librarian*: Mr. B. N. Maitra. *Other Members of the Council*: Prof. M. Chatterjee, Dr. P. K. Ghosh, Mr. H. M. Lahiri, Mr. D. C. Nag, Mr. G. G. Narke, Mr. B. Rama Rao, Prof. S. K. Roy, and Mr. K. K. Sen Gupta.

In the course of his Presidential address, Mr. M. M. Mukherji dealt with the *Present Day Problem of the Indian Coal Industry*. The principal mining industry of India, *viz.*, the coal industry, is now practically on the verge of collapse. This is partly due to the economic depression and partly due to the very wide margin that exists between demand and the immediately available productive capacity. The latter is really more serious because the surplus productive capacity of the mines induces the owners to sell their coal at any price, which ultimately proves detrimental to the producers as a class.

The question is how to rescue this industry from the quagmire of depression? The one immediate remedy suggested is the closing down of the Railway Collieries. Out of the total consumption, the Railways account for over 34 per cent. Although it is true that at present the Railway collieries supply only a part of this, they possess potential possibilities for supplying the whole of the Railway requirements. Their closure will automatically restrict the output and cannot

fail to have a salutary effect on the industry. The Railway Authorities contend that the closure of the collieries would mean a recurring expenditure of 41 lakhs of rupees a year for maintaining them in good working condition. Mr. Mukherji suggests that the coal trade will not probably be unwilling to pay this amount, if Government would collect that sum by levying some cess on coal despatched as long as Government is not in a position to sell those collieries at a fair price.

Mr. Mukherji also dealt with the problem of metallurgical coke. This particularly valuable class of coal far from being conserved for use in industries, for which they are eminently suited, is being used for purposes where inferior grades would suffice. It has been estimated that for the years 1931 and 1932, of the total amount of coal mined in India suitable for the manufacture of metallurgical coke, only 13.9 and 14.7 per cent. respectively was used for the manufacture of hard coke. The Coal Fields Committee reported "that the Railways should be recommended to use more of inferior coals for shunting purposes in marshalling yards and that mills and other industrial consumers might also adjust a type of furnace specially designed for burning low grade fuel." The problem of conservation of metallurgical coal is of vital interest to the growth of the metallurgical industry in India.

The embargo placed on the export of coal in 1920, resulted in the "disappearance of Indian Coal for overseas market for the time being" and to recapture a lost market, strenuous efforts and Government's active assistance are needed. It is mentioned that India obtained in 1920 one and half crores of rupees by exporting coal, while in 1933, she realised only 41 lakhs through her exports.

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International Commission of Agriculture.—The Commission held its general assembly at Brussels and Gumbloux (Belgium) under the chairmanship of the Marquis de Vogue (France), President. The assembly devoted special attention to the present condition of Agriculture, which appears to have grown worse in spite of the useful measures taken in certain countries. The two main problems which require solution are (1) the wheat problem, and (2) the edible fat problem. According to a report in *Nature*, the Commission resolved to hold its next meeting in 1936, in Oslo, and the twelfth International Congress will take place at The Hague in 1937.

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Empire Meteorologists' Conference.—The third Conference of the Empire Meteorologists was held at South Kensington on August 12–21. The meetings provided an opportunity for Directors of Services to exchange views on diverse subjects. Considerable attention was devoted to meteorological arrangements necessary to meet the Government's requirements in connection with the Empire Air-Mail Service. A few problems arising in this connection are the making of synoptic charts on a uniform plan and the coding of reports from land stations and air-ships. Other subjects discussed concern meteorology for the Army and for the Navy, instruments, upper air observatories, marine meteorology, geophysics, climatology and agriculture and seasonal forecasting. In connection with geophysics, the Conference passed a resolution recommending the establishment of a station at Chesterfield Inlet, Hudson's Bay, Canada. This station would be in near proximity to the North Magnetic Pole and its situation would also be very favourable to auroral studies. The Conference also recommended the establishment of a station at Tristan la Cunha, observations from which, situated as it is, about midway between the Cape of Good Hope and South America, would be of great value. Regarding climatology and agriculture it was suggested that climatological data should be broadcasted. The outline of a scheme was proposed for broadcasting of brief data from related stations in each country on the fifteenth of the month following that to which the data refer.

Twenty-five dominions and colonies were represented at the Conference.—(From *Nature*, September 7, 1935).

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The International Faculty of Science (Central Office: 85, Gloucester Place, London).—At the meeting of the Council and Executive Committee held on Wednesday last (September 4th, 1935), a resolution was unanimously carried "that Professor M. Sayeed-ud-Din be appointed a Vice-President of the Faculty for India, in the place of Professor Hunter, resigned".

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Dr. Friedrich Levi has been appointed Hardinge Professor of Higher Mathematics, in the University of Calcutta. Dr. Levi was formerly extraordinary Professor of Mathematics at the University of Leipzig. The appointment is made for a period of five years.

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Sir Josiah Stamp, statistician and reputed economist, Chairman of the London Midland and Scottish Railway, has been elected President of the British Association for the Advancement of Science, 1936.

The British Association will meet at Blackpool next year from September 9 to 16, and will visit Nottingham in 1937, Cambridge in 1938, and Dundee in 1939. The 1940 meeting will be in Australia.

It is suggested that a select party of the British Association be sent in winter of 1937–38 to take part in the Jubilee Meeting of the Indian Science Congress.

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Mr. R. M. Statham has handed over charge to Sir George Anderson, as Education Commissioner to the Government of India.

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Sir Richard Paget, Bart., recently announced at the International Congress of Phonetic Sciences that the most universal language is that of signs. Sir Richard has been comparing the sign-languages all over the world and he is of opinion that the sign-language is so fundamental and natural that uneducated deaf mutes from the Far East or African jungles can talk with English deaf mutes and make themselves understood.

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Col. Gill, the Malaria Expert, who was specially appointed by the Government of Ceylon to investigate the causes of the epidemic in November last, has recently submitted his report to the Executive Committee of Health. The epidemic of 1934–35 which overtook that Island was of exceptional magnitude, and it is predicted that

for some decades to come an epidemic of that intensity will not occur. Another epidemic is however predicted in 1940. The last sweep accounted for over 38,000 deaths in three months, and forty lakhs of rupees have already been spent by the Government for relief measures, and a sum of fifteen lakhs of rupees has been provided in the new budget. It is understood that Col. Gill recommended the enactment of an anti-mosquito ordinance to arm Government and local authorities with powers to insist on tenants of houses and estate owners to carry out all reasonable anti-malarial measures. No special organisation for controlling malaria is called for, and the local malarial organisation should be sufficient to deal with the control measures.

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Fridera.—The causes leading to the premature failure of wooden sleepers in railways, is due to (1) mechanical abrasion, and (2) natural decay. The former is accentuated by the looseness of rail fastenings; this is otherwise called 'Spike-killing'. The chemical destruction of wood fibres at the rail seat also adds to the failure of wooden sleepers, thus rendering them unsuitable, long before they become useless through natural decay. At the request of the Railway Board, the Chemical Branch of the Forest Research Institute, Dehra Dun, undertook to evolve a composition which could be melted and poured into the worn-out spike holes, and the spikes then fixed into position; when cold the composition would set hard and have a firm grip both on the wood and the rail. The manipulation should be made *fool-proof* and the composition should have a sufficiently high fusion point to withstand the summer heat of India (temperatures up to 150° F.). A composition has been evolved and patented by Dr. S. Krishna under the name of *Fridera*. The holding power of the composition is excellent, requiring a load of 6,000–7,000 lbs. to pull out the spike, the untreated wood requiring 3,000–4,000 lbs. only. Trials have been made upon tracks and proved satisfactory. Tests conducted by Mr. V. D. Limaye at the Forest Products Laboratories, Canada, have shown that *Fridera* does not lose its grip at low temperatures, as low as −20° F. It has thus been demonstrated that *Fridera* retains firm grip both on metal and on wood under extreme variations of temperature.

The Forest Research Institute has also been responsible for developing and patenting an efficient wood preservative under the name *Ascu* (Patented by Mr. S. Kamesam) which increases the durability and life of wood, and makes possible the utilisation of sap woods and jungle woods for construction purposes (see *Curr. Sci.*, 1935, **4**, 89). It is thus possible to reduce considerably the heavy expenditure incurred in renewal of sleepers by (1) minimising mechanical abrasion by the use of *Fridera*, and (2) by prolonging the life of the wood by treatment with *Ascu*. (Extract from *Indian Forester*, 1935, **61**, 660.)

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In an interesting note published in *Nature* (September 7, 1935) Mrs. Barlow has, as a result of her examination of the unpublished Darwin manuscripts, brought out evidence to show that as early as September 1835 Darwin began to question the stability of species. It is generally held that during the weeks spent at the Galpagos Islands, Darwin first considered the possibility of the transmutation of species. The question, at what period during the *Beagle* voyage did his views crystallise?, appears to have been answered by the occurrence of a significant passage "for such facts would undermine the stability of species." in Darwin's unpublished manuscripts dealing with the fauna of Galpagos Islands.

* * *

In spite of warnings given repeatedly, three or four fatalities and many severe burning accidents have resulted from the use of *sodium chlorate* as a weed-killer in New Zealand. Injuries have also resulted to some farmers who have used sodium chlorate mixed with sulphur or sugar for blasting purposes. Two or three farmers have been prosecuted.—(*Chemical Age, Sept.* 1935.)

* * *

An earthquake shock of moderate intensity resulting in minor damages to buildings was felt at Taikkyi, in Burma, on the 1st October at 12.44 p.m. The epicentre is believed to be about 50 miles away from Rangoon and the duration of the shock was 2 minutes.

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Royal Institute of Science, Bombay.—Dr. T. S. Wheeler, Principal of the Institute, has been re-elected Dean of the Faculty of Sciences of the Bombay University for the next academic year.

Prof. P. R. Awati of this Institute and Dr. Venkatraman of the University Technology Institute have been appointed local Secretaries of the Second Meeting of the Indian Academy of Sciences, to be held next December in Bombay.

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The Journal of the Indian Mathematical Society (*New Series, Vol.* 1, *No.* 6).—The conception of the line of striction of a singly infinite family of curves on a surface is due to C. E. Weatherburn (*vide Math. Gazette, Vol.* 13). Mr. V. Rangachariar (Patna) in a paper in the present issue of the *Journal* examines under what circumstances the line of striction of a system of asymptotic lines of a minimal surface can be a trajectory of the system.

Dr. R. Vaidyanathaswamy, M.A., D.Sc., presents a paper on the Extension of the Determinant Concept, wherein by using methods based on Group-Theory, he improves upon a previous publication of his, entitled "On Mixed Determinants."—(*Proc. Roy. Soc. Edinburgh*, 1925.)

R. Vaidyanathaswamy and B. Ramamurti have a note on the "Rational Norm Curve", wherein they make a further study of a correspondence between quadric envelopes in S_n and linear line complexes in S_{n+1} studied by R. Vaidyanathaswamy elsewhere.–(*Jour. Lond. Math. Soc.*, 1932.)

C. N. S.

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Journal of the Bombay Natural History Society.—We have received Vol. **38**, No. 1, of the *Journal of the Bombay Natural History Society, Bombay*, and we note that it abounds in articles relating to faunistic and floristic natural history. There is a most thrilling article on Rhinoceros Shooting in Burma and it makes very interesting reading particularly after following Mr. Morris's account of the hunt for a rare species of Rhinoceros needed for the American Museum of Natural History. Mr. W. S. Thom, the author of the article in the journal, tells us that specimens of *R. sumatrensis* are very common

while the single-horned *R. sondaicus* is not at all met with though it is said to exist in Burma. There are other articles on Game birds, Game sanctuary, Ornithology of Travancore and Cochin, Caddis-flies, Flora of Bombay Presidency, Papaw tree, Beautiful Indian trees, Medicinal and poisonous sedges of India and others. Besides reviewing some important books, a large number of pages is devoted to miscellaneous notes and no less than 43 short articles of natural history interest are published under this head.

* * *

Recent Publications.—

His Majesty's Stationery Office, London.—Department of Scientific and Industrial Research.—Fuel Research Technical Papers, Nos. 40 and 41. The Hydrogenation-Cracking of Tars. Part I. Preliminary Experiments. Price 2*s.* net. Part II. The Preparation of a Catalyst. Price 6*d.* net.

Report of the Food Investigation Board for the year 1934. Price 1*s.*

Cambridge University Press, London.—The Optical Basis of the Theory of Valency, by R. De L. Kronig. 16*s.* net.

Thomas Murby & Co., London.—Transactions of the 3rd International Congress of Soil Science, 1935, Vol. I (23*s.* to members of the International Society and 28*s.* to non-members). Vol. II. (11*s.* to members and 13*s.* to non-members).

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Announcement.—

Indian Central Cotton Committee.—Facilities for Training at the Technological Laboratory, Matunga, Bombay.—As in the past the Technological Laboratory will admit this year two students for training in the elements of spinning and the routine methods of testing cotton fibre and yarn. The selected candidates will be expected to join on the 2nd December 1935 and will conform to the Laboratory regulations regarding hours of work, etc. The course will normally last for a period of six months and a fee of Rs. 50 only will be charged for the full course.

Candidates desirous of admission should submit written applications to the Director, Technological Laboratory, Matunga, Bombay, so as to reach him not later than the 1st November 1935.

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International Geological Congress.—Seventeenth Session, USSR, 1937.

In view of the fact that the twentieth anniversary of the existence of the Soviet Power will be celebrated in 1937, the Government of USSR has decided to summon the Seventeenth International Geological Congress that year.

The session will open in the beginning of August and July will be devoted to excursions before the Congress, and the second half of August and September for excursions after the Congress. The Organisation Committee has proposed the following topics for discussion at the session:—

(1) Problem of Petroleum and Petroleum Resources of the World.
(2) Geology of Coal Fields.
(3) Pre-Cambrian and Mineral Deposits in Regions of its Expansion.
(4) Permian System and its Stratigraphical Position.
(5) Correlation of Tectonic Processes, Magmatic Formations and Ore Deposits.
(6) Tectonic and Geochemical Problems of Asia.
(7) Deposits of Rare Elements.
(8) Geophysical Methods in Geology.
(9) History of Geological Knowledge.

The Committee welcomes suggestions regarding further topics suitable for discussion.

Five excursions taking 15–28 days have been planned before the session; and four large excursions covering very wide regions and taking 40–50 days, after the session.

Those who wish to offer suggestions to the Organisation Committee concerning the Seventeenth International Geological Congress, are invited to communicate with the Committee, Moscow 4, Kotelnicheskaya Naberezhnaya, 17. Telegraphic Address: Moscow, Geocongress.

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We acknowledge with thanks the receipt of the following:—

"Transactions of the Faraday Society," Vol. XXXI, Parts 9 and 9*a*, September 1935.

"Agricultural Gazette of New South Wales," Vol. XLVI, Parts 7, 8 and 9.

"The Allahabad Farmer," Vol. IX, Nos. 2–5.

"Journal of Agricultural Research," Vol. 51, No. 1.

"Journal of Agriculture and Livestock in India," Vol. V, Parts 3 and 4.

"The Journal of the Royal Society of Arts," Vol. LXXXIII, Nos. 4318–4322.

"The Journal of the Indian Botanical Society," Vol. 14, Nos. 3 and 4.

"Canadian Journal of Research," Vol. 13, No. 2, Sections A, B, C, and D.

"Chemical Age," Vol. 33, Nos. 843–847.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 68, No. 9.

"The Journal of Indian Chemical Society," Vol. 12, Nos. 8 and 9.

"Experimental Station Record," Vol. 71, Index; Vol. 73, Nos. 1 and 2.

"Indian Forester," Vol. LXI, No. 10, October 1935.

"Forschungen und Fortschritte," Vol. II, Nos. 25–27.

"Indian Forest Records," Vol. I, Nos. 1–4. (Entomological Series.)

"Department of Commercial Intelligence and Statistics, India: Monthly Statistics of the Production of Certain Selected Industries of India," April and May 1935.

"Publications from the Department of Agriculture, Dominion of Canada—

Soil Drifting Control in the Prairie Provinces, by E. S. Hopkins, S. Barnes, A. E. Palmer and W. S. Chepil, Bulletin No. 179—New Series.

Hardy Roses, Their Culture in Canada, by Isabella Preston with contributed Sections on Insect Pests and Diseases, Bulletin No. 17—New Series.

Goat Husbandry in Canada, by A. A. MacMillan, Bulletin No. 177.

Progress Report of the Chief Supervisor, J. C. Moynan, B.S.A., on—

Division of Economic Fibre Production, Progress Report of the Chief Officer, R. J. Hutchinson, for the years 1931 to 1933.

The Illustration Stations in Prince Edward Island, Nova Scotia, New Brunswick, Quebec and Ontario, for the years 1931, 1932 and 1933.

Do. in Manitoba, Saskatchewan, Alberta and British Columbia, for the years 1931 and 1933 inclusive.

Varietal Studies of Flue-Cured, Burley and Dark Tobaccos, by N. A. Macræ and R. J. Haslam, Bulletin No. 178—New Series.

The Vegetable Garden, by W. S. Blair, Pamphlet No. 166—New Series."

"Department of Commerce and Industries, Fisheries and Marine Biological Survey," Fishery Bulletin No. 1 (Union of S. Africa).

"Medico-Surgical Suggestions", Vol. 4, No. 8.

"Memoirs of the Indian Meteorological Department," Scientific Notes, Vol. VI, No. 64.

Some Observations on the Thermal Structure of Cumuliform Cloud, by Flt.-Lieut. R. G. Veryard, B.Sc., R.A.F.

"Journal of the Indian Mathematical Society," Vol. I, No. 6.

"Scripta Mathematica," Vol. III, No. 3, July 1935.

"Nagpur Agricultural College Magazine." Vol. 10, No. 1.

"Nature," Vol. 136, Nos. 3434–3438.

"The Journal of the Bombay Natural History Society," Vol. 38, No 2.

"The Journal of Nutrition," Vol. 10, No. 2.

"The Journal of Chemical Physics," Vol. 3, No. 9.

"Science and Culture," Vol. I, No. 5.

"The Indian Trade Journal," Vol. CXVIII, Nos. 1525–1528.

"Indian Journal of Venereal Diseases," Vol. I, Nos. I–III.

CATALOGUES.

"Mitteilungen über Neuerscheinungen und Fortsetzungen," 1935, Nummer 4 (September) (Verlog von Gustav Fischer in Jena).

New Books, Autumn 1935 (Messrs. Edward Arnold & Co., London).

Academies and Societies.

National Institute of Sciences of India:

August 24th, 1935. The following papers were read and discussed:—

(1) R. N. CHOPRA, S. N. MUKHERJEE AND K. V. KRISHNAN: *A Note on the Role of Electrical Charge in the Phagocytosis of Red Cells in Malaria.*– It is now an accepted fact that the immunity as observed in malaria is the outcome of the phagocytic activity of leucocytes. The idea regarding this activation on the part of the phagocytes still centres round the formation of a specific antibody in the system as in bacterial infections, although the existence of such an antibody could not be definitely established by different workers; (Thomson, J. G., *Brit. Med. Jour.*, 1918, **2**, 628; Kingsbury, A. N., *Trans. Roy. Soc. Trop. Med. Hyg.*, 1927, **20**, 359; Manson Bahr, P., *Trans. Roy. Soc. Trop. Med. Hyg.*, 1927, **21**, 63, etc.). Brown (*Brit. Jour. Exper. Path.*, 1933, **14**, 113) from an analogy of the changes in the proteins of the serum and in the electrical charge of red cells indirectly indicated the probability of the existence of an antibody which, by reducing the electrical charge on red cells, was instrumental in bringing about ingestion by leucocytes, though he admitted that the action of serum in such cases was not specific. The work of Chopra and Chaudhury (*Ind. Jour. Med. Res.*, 1933, **21**, 273) showed however that the electrical charge of red cells in human malaria did not always show a reduction, but on the contrary a marked increase in many cases. Hence the immunochemical explanation of the increased phagocytosis in malaria did not seem to be adequate specially in view of some definite biochemical alterations observed in the blood.

The present work was done on *Silenus rhesus* monkeys with a heavy infection (nearly 70% of the red cells) of *Plasmodium knowlesi*. Migration velocity in an electric field of infected and uninfected red cells were determined in the different stages of parasites' growth. The migration velocity of the reticulocytes, popularly believed to be free from protozoal attack, was also determined.

The first point observed was an inequality of speed between infected and uninfected cells that was manifested by the overtaking of one cell by another. Infected cells, in general, were found to be slower. This was contrary to all experience in the case of normal cells. Secondly, a study of the variation of migration velocity in different stages of parasites' growth revealed an increase of migration velocity in the ring stage and a marked decrease in the fully mature schizont stage as compared to normal cells. The healthy cells in these infected specimens all along showed a slight increase. An inference was arrived at from these observations that towards the end of schizogony when the mobility was comparatively lower, the phagocytosis of such infected cells should be more prominent. The equality of the migration velocities of reticulocytes and adult red cells pointed to the possibility that reticulocytes should be equally liable to be infected with parasites as adult red cells are found to be. Infected reticulocytes were actually detected in one case and the relative freedom of these from infection was explained as not due to any peculiarity on the part of such cells but probably to their insignificant numbers in the blood, owing to which, according to the calculus of probability, a small infection should be the result.

The relationship between the migration velocity and the electrical charge was discussed in the light of Lamb-Helmholtz equation: $U_o = D.E/4\pi$. The relationship between electrical charge and phagocytosis was again given by the term $e\text{-}q\cdot q'/D.d.k.T$. U_0 represents migration velocity per unit time, per unit potential gradient: D, the dielectric constant of the medium; E, the potential of the Helmholtzian double layer; q, the charge on a red cell; q', the charge on an ingesting white cell; d, the distance between the centres of these two types of cells at the point of their nearest approach; k, the Boltzmann constant; T, the temperature in the absolute scale and e, the base of natural logarithms. This term was deduced from a consideration of the

electrical work necessary for the approach and collision between two similarly charged particles as in the case of colloid micelles. From this the inadequacy of the part played by the electrical charge of red cells alone in such phenomenon was clearly evident; the importance of the charge of white cells as well as of the dielectric constant of the medium was simultaneously brought out from a theoretical point of view. The changes in the cholesterol content of the plasma and its effect upon the phagocytosis of red blood-cells in a few cases justified our conclusions to a certain extent. The phagocytosis of the actual protozoa during their short extracellular existence was dealt with from the mathematical considerations of probability and finally the importance of the physical factors and of the biochemical alterations in the plasma were also brought out from a theoretical point of view.

(2) W. D. WEST: Nappe *Structure in the Archæan Rocks of the Central Provinces.*—Evidence is brought forward to show that around Deolapar, in the Ramte tahsil of the Nagpur district, there occurs a sharp discordance in the succession of the Sausar series, at which position one or more stages are missing. The trace of the discordance is an irregular closed line, and it is clearly not a simple thrust. The details of the structure suggest that there is a recumbent fold resting upon the surrounding rocks, from which it is separated by the discordance. Both the recumbent fold and the "slide" upon which it rests have been further folded into a syncline. A study of the lithology also supports this view of the structure, since the rocks forming the *nappe* are of a different facies from the rocks surrounding it. It is suggested that the two sets of rocks were far separated at the time of their deposition, and have since been brought into juxtaposition with one another by horizontal movement along the slide.

(3) HORACE BARRATT DUNNICLIFF AND JNANENDRA NATH RAY: *Loss of Morphine in Indian Opium on Storage.*—(*a*) Moist opium does not lose morphine on storage. (*b*) Opium dried at 60° C. stored in contact with air suffers a rapid loss of morphine. This is not completely prevented by storage in corked and paraffined bottles. (*c*) Opium dried at 98–100° and stored out of contact with air does not lose morphine to any appreciable extent. (*d*) There is no evidence of the formation of ammonium salts as a result of the oxidation. (*e*) An enzyme (peroxidase) has been isolated from Malwa opium which may be the factor responsible for the decomposition of morphine. (*f*) A fungoid growth noticeable on moist opium has been identified as that of *Scopulariopsis brevicavtis*, var. *glabra Thom.* (*g*) When this fungus is made to grow in a dilute solution of morphine hydrochloride in a suitable nutrient medium, a slight fall in the concentration of morphine is observed but the specific rotation of the solution does not change appreciably.

Indian Academy of Sciences:

September 1935. SECTION A.—R. PADMANABHAN: *Fluorescence in Cyclohexane.*—With the help of a continuous distillation apparatus it is shown that pure cyclohexane has no fluorescence. K. L. RAMASWAMY AND G. GUNDU RAO: *The Density and Compressibility of Silicane and Silicoethane.*—A convenient apparatus for their simultaneous measurement and the results obtained are given. R. S. KRISHNAN: *Molecular Clustering in Binary Liquid Mixtures (Variation with Composition and Temperature).*—A study of the intensity and depolarisation of the light scattered transversely by mixtures of phenol and water at different temperatures shows that formation of clusters and their size depend upon temperature and composition. M. A. GOVINDA RAU AND S. SATYANARAYANA RAO: *On the Dipole Moment of Tetralin.*—The moment is only small of the order 0.4×10^{-18}, and not 1.66×10^{-18} as reported in the literature. B. V. RAGHAVENDRA RAO: *Doppler Effect in Light Scattering in Liquids. Part II.—Polarisation of the Transversely Scattered Radiations.*—With the typical liquids carbon tetrachloride, toluene and carbon disulphide, it is significant that besides the two Doppler components, the central component is also practically completely polarised. I. CHOWLA: *A Theorem on the Addition of Residue Classes: Application to the Number $\Gamma(k)$ in Waring's Problem.* V. N. THATTE: *Magnetic Double Refraction and Light Scattering in Fused Nitrates.*—The magnetic and optical anisotropies of the NO_3 group are the same as in nitric acid and crystalline nitrates. S. RAMACHANDRA RAO: *Diamagnetism of Copper.*—On colloidalisation of copper, the diamagnetic susceptibility increases, the critical diameter below which large changes occur being $0.8\,\mu$. C. S. VENKATESWARAN: *The Raman Spectrum of Phosphorus.*—Yellow phosphorus as vapour, liquid, solid and solution in carbon disulphide has been studied. M. V. NABAR AND T. S. WHEELER: *The Kinetics of Heterogeneous Organic Reactions: The Reaction between Benzyl Chloride and Solid Silver Nitrate.*—The reaction is independent of the amount of benzyl chloride but is proportional to the surface of silver nitrate present. C. S. VENKATESWARAN: *The Raman Spectra of Dioxane and Tetralin.* R. ANANTHAKRISHNAN: *The Raman Spectra of Heavy Water.*—The principal band is found to have a triple structure and two other new bands have also been observed. S. BHAGAVANTAM: *Raman Spectrum of Deuterium: I.*—With deuterium at 17 atmospheres, five rotational lines and one vibrational line are recorded. The positions and intensities of these lines provide the first experimental confirmation of the theories regarding the D_2 molecule. S. BHAGAVANTAM: *Raman Spectrum of Hydrogen Deuteride.* L. SIBAIYA: *Hyperfine Structure in Selenium, Palladium and Gold.*—In Selenium and Palladium none of the levels examined reveals any even isotope displacement.

SECTION B.—T. N. S. RAGHAVACHARI AND P. V. SEETHARAMA IYER: *The Use of Activated Carbon in the Purification of Water in the Tropics (The Madras City Water Supply).*—Activated granular carbon when used in a slow sand filter, as a sandwiched layer 1½" thick, is effective in removing the colour, taste and odour. The organic matter is reduced; the carbon maintains its efficiency even after 2 years' continuous service. CHARLES S. PICHAMUTHU: *The Conglomerates and Grits of Kaldurga, Kadur District, Mysore.*—As the result of a detailed study of the pebbles and the matric, the writer has come to the conclusion that the conglomerates are not autoclastic as held hitherto, but that they are of a sedimentary origin.

M. J. PRESSWALLA AND C. J. GEORGE: *The Respiratory System and the Mode of Respiration of the Water-Bug*, Sphærodema rusticum *Fabr., with Remarks on those of* Nepa, Laccotrephes *and* Ranatra.—The respiratory systems of the two forms of adult *Sphærodema rusticum* exhibiting peculiar alary dimorphism have been studied in detail. (MISS) KAMALA BHAGVAT AND MOTNAHALLI SREENIVASAYA: *A Dilatometric Method for Studying the "In Vitro" Digestibility of Milks.*—The dilatometric method affords an accurate and simple method for studying the digestions of milks. The behaviour of the casein particles in cow's milk towards tryptic digestion does not appear to be different from that of the casein particle in artificial solution. N. C. DATTA: *Investigations on Metallic Contamination of Foods. Part II.—Effect of Cooking and Storage of Foodstuffs in Aluminium Vessels.*—Feeding experiments with rats have shown that food prepared in aluminium vessels has no harmful effect on growth, reproduction and general well-being of the animals. H. B. SREERANGACHAR: *Dilatometric Studies in the Enzymic Hydrolysis of Polysaccharides. III.—Hydrolysis of Starch, Amylose and Amylopectin by Takadiastase.*—The depression per millimol release of maltose from potato starch, soluble starch (Lintner), amylose and amylopectin, are respectively 4.0, 4.0, 3.6 and 3·6 mm.^{3}. The depression per degree fall in rotation is 10.7 mm.^{3} in the case of both amylose and amylopectin.

Symposium:

October 5th and 6th, 1935. *Disease Resistance in Plants* (held at Coimbatore).

GENERAL.

(1) L. D. GALLOWAY (Pusa): *The Control of Fungal Parasites by the Plant.*—The control of harmful fungi can be considered under (*a*) infection, (*b*) humidity, (*c*) nutrition, (*d*) temperature, and (*e*) atmosphere. Infection may be seed, soil or air-borne and disease may be avoided by minimising chances of infection. In the study of the onset and progress of diseases humidity is an important factor but very little work appears to have been done. The problem of specificity of certain pathogenic fungi and the cosmopolitan nature of others has not been satisfactorily solved. The role of soil nutrient and the action of poisons and toxins on plants has to be clearly investigated. The growth of the parasites and the resistance of the host are controlled by temperature and the aid of certain chemicals like CO_2, NH_3, $CH_3.CHO$, which have an inhibitory effect on the growth of fungi can be invoked for controlling several fungus diseases. The mechanism of disease resistance presents fresh series of problems for each host plant and each parasite and no general formula is to be anticipated.

DISEASES OF THE PULSE CROPS.

F. J. F. SHAW (Pusa): *The Inheritance of Morphological Characters and of Wilt Resistance in Rahar* (Cajanus indicus).—From a study of the F_1, F_2 and F_3 generations of a cross between a resistant and susceptible varieties of *Cajanus indicus*, evolved at Pusa, it has been shown that the resistance to wilt is conditioned by the presence of the complimentary character. Morphological characters like flower colour, erect or spreading habit of growth, tall or short structure of plant, crowded or open inflorescence and brown and grey markings of the seeds are inherited *independently* of the factors influencing the resistance to wilt.

V. RAMANATHA IYER AND R. BALASUBRAHMANYA IYER (Coimbatore): *A Preliminary Note on the Mode of Inheritance of Reaction to Wilt in* Cicer arietinum.—The reaction to wilt in this crop belongs to the blending type of inheritance manifesting transgressive variation. The type of branching and the colour of the seed coat do not bear any relation with the reaction to disease.

DISEASES OF THE COTTON.

K. N. AMBIGAOKAR AND YESHAVANT D. WAD (Indore): *Studies in Disease Resistance. I.—Cotton Wilt and Environmental Conditions.*—An account of three years' work on the physiology of the cotton plant in relation to wilt. Field observations showed that the progress of wilting in the field may be modified by soil differences, irrespective of its inhibition intensity. Root activity in the upper soil zones was found to be significantly less in diseased plants than in healthy ones. An excessive supply of nitrogen, alone or with phosphate, increased susceptibility. Farmyard manure had no influence.

I. MADHUSUDAN RAO AND YESHAVANT D. WAD: *Studies in Disease Resistance, II.—Leaf-Roll and Red-Leaf in American Cottons.*—Physico-chemical studies of the saps of healthy and affected wilt plants have been made. The pH was greater and the osmotic pressure lower in healthy leaves than in the diseased ones. Studies on soil profiles and the root systems of healthy and affected plants have been carried out in detail. There is generally no visible difference in the soil profiles, under healthy and diseased plants. The root-studies indicate that the high death-rate (as compared with that in normal plants) in the active roots in the upper zone (1 foot) reduce the activity in the roots of lower zone in diseased plants. The disease was produced whenever the surface soil was deflocculated after long continued wetting.

SPIKE-DISEASE OF SANDAL.

M. SREENIVASAYA: *Spike Disease and Resistance in Sandal* (Santalum album *Linn.*) *with Special Reference to its Control.*—The control of this disease presents special problems since the disease affects an extensive crop which takes several years to reach a stage of exploitable maturity. The plant demands during this long period a considerable amount of care and attention by way of tending, host conservation and fire protection. The selection of suitable host plants has proved useful in imparting immunity to sandals effecting rogueing by defoliation has proved useful to detect masking plants. While enforcing methods of plant sanitation has proved helpful in controlling this infectious disease, success has not yet attended the attempts to evolve resistant strains.

B. N. SASTRI: *Physiology of the Spike Disease of Sandal.*—The factors responsible for the accumulation of starch, mannitol and succinic acid in spike tissues have been discussed.

PIRICULARIA ORIZÆ.

K. RAMIAH AND K. RAMASWAMI: *Breeding for* Piricularia *Resistance in Rice* (Oryza sativa).—Breeding work has resulted in obtaining two strains which are not only resistant to the disease but also give a bigger yield than the suscepti-

ble variety. The inheritance studies in this cross would make it appear that resistance to *Piricularia* is a simple recessive.

DISEASES OF SUGARCANE.

C. S. KRISHNASWAMY: *Studies in Disease Resistance in Crop Plants in the Madras Presidency. II.—Estimation of Disease Resistance in Sugarcane Mosaic.*—150 varieties of cane have been tested since 1926 for their resistance to mosaic. The percentage of incidence of mosaic in a variety when interspersed with the diseased cane Co 213, which is taken as standard, gives a measure of the relative resistance of the variety under trial. The studies have shown that immune varieties are rare as even highly resistant varieties are capable of taking up infection under special conditions. An analysis of the factor of disease resistance on morphological and histological characters has been made.

N. L. DUTT, SYED ABBAS HUSSAIN AND M. K. KRISHNASWAMI: *A Note on the Breeding of Sugarcane Varieties Resistant to Mosaic.* As a result of the extensive inter-varietal, inter-specific and inter-genetic crosses, a large number of seedlings are available representing all gradations of resistance to mosaic, from susceptible to immune. Seedlings which contain the blood of *Saccharum spontaneum* have proved highly resistant or immune while on the other hand those that do not contain *spontaneum* blood show a high percentage of mosaic infection. With regard to the mosaic resistant varieties, cases have been recorded where the resistance is found to vary geographically. This is perhaps due to the existence of physiologic races of the causal agent.

K. L. KHANNA: *Some Aspects of Disease Resistance in Sugarcane. I.* Plant Vitality, Tentative 'Susceptibility' and 'Resistance' ranges to incidence of pests (shoot borers) and diseases (top rot and red stripe), at different stages of growth, in different seasons and from different treatments such as manures, irrigation and soil types, have been measured and by injecting oxidising agents and certain chemicals and also exposure to component rays of white light, it is possible to raise the vitality of the plants to resist diseases and pests. *II. Morphological and Physiological.*—Some of the characters responsible for differences in varietal predisposition and resistance have been noted. *III. General.*—The relative position of 'major' and 'minor' diseases has been discussed in relation to the rapidly changing varieties as a result of breeding improved types of sugarcane.

SHOOT ROT OF COCONUT.

J. S. PATEL AND A. P. BALAKRISHNA NAYAR: *Natural and Induced Resistance to Shoot Rot* (Gleosporium sp.) *in the Coconut.*—From observations made on large varieties of coconut collected from different parts of the world, and grown at the Government Agricultural Research Station, Pilicode, it is seen that a variety from Philippines showed the lowest percentage of infection (37 per cent.) and a variety from Mysore showed the highest (87 per cent.). The disease occurred in palms 3–9 years of age and thereafter the trees are generally less susceptible. The susceptibility is more pronounced in trees planted on the surface than in the trees planted at a depth of 3 feet. The incidence of disease is considerably reduced when potassium sulphate is applied to the soil.

The Academy of Sciences, U. P.

September 1935. *Special Meeting of the Academy.*—It was resolved (1) to change the name of the Academy to "The National Academy of Sciences, India" and (2) to raise the number of Fellows from 30 to 100.

September 18th, 1935. *Ordinary Meeting of the Academy of Sciences, U.P.*—The following papers were read and discussed:

RADHA RAMAN AGARWAL AND SHIKHIBHUSAN DUTT: *The Chemical Examination of Punarnava or* Boerhaavia diffusa *Linn. Part II.—The Isolation of an Alkaloid Punarnavine.* B. P. PANDE: *On Amphistomes with Central Pouch from India.* HRISHIKESHA TRIVEDI: *The Absorption Spectrum of Hydrogenchloride Molecule and its Upper Unstable State.*—By the help of a theory developed by the author previously it is possible to calculate the form of the potential energy of the unstable state of hydrogen chloride from the measurements of its absorption coefficient. The form has been known only qualitatively up till now. HAR DAYAL SRIVASTAVA: *New Hemiurids (Trematoda) from Indian Marine Fishes. Part I.—New Parasites of the Sub-Family* Prosorchinæ *Yamaguti*, 1934. HAR DAYAL SRIVASTAVA: *New Allocreadids (Trematoda) from Indian Marine Fishes. Part I.—New Parasites of the Genus* Halicometrina *Linton*, 1910. HAR DAYAL SRIVASTAVA: *New Allocreadids (Trematoda) from Indian Marine Fishes. Part II.—New Parasites of the Genus* Decemtestis *Yamaguti*, 1934.

The Indian Physical Society:

September 21st, 1935. An ordinary monthly meeting of the Indian Physical Society was held at 3 P.M. in the Applied Physics Seminar, University College of Science, Calcutta, with Principal B. M. Sen, M.A., I.E.S., in the Chair. The following papers were read and discussed:

(1) N. K. SAHA (Lahore): *Pressure Coefficient of Electrical Resistance of Metals.* (2) P. LAL AND K. LAL (Lahore): *On the Statistical Theory of Neutral Atoms.* (3) D. V. GOGATE (Baroda) AND D. S. KOTHARI (Delhi): *On the Measurement of the Quantity of Light by the Photoelectric Cell.* (4) K. PRASAD AND B. N. GHOSH (Patna): *Studies on Water Jets.* (5) P. SYAM (Calcutta): *On the Absorbing D-Layer of the Ionosphere.* (6) P. C. MAHANTI (Calcutta): *Fine Structure Analysis of Red Bands of Magnesium Oxide and Isotopic Effect.* (7) P. C. MAHANTI (Calcutta): *Potential Energy Curves and the Structure of the Alkaline Earth Oxides.* (8) S. DATTA AND M. DEB (Calcutta): *Investigations on the Ultraviolet Absorption Spectrum of* Ce^{+++} *ion.* (9) H. P. DE (Calcutta): *State of Polarisation of Continuous X-Rays from a Thin Aluminium Anticathode.* (10) H. P. DE (Calcutta): *On the Emission of Positrons from Bismuth.*

The Indian Chemical Society:

August 1935. H. B. DUNNICLIFF AND BRAHM PRAKASH: *Action of Hydrogen Sulphide on Insoluble Chromates. Part I.—Lead Chromate and Silver Chromate.* S. S. BHATNAGAR, P. L. KAPUR AND N. R. VERMA: *Magneto-Optical Rotation of Uranyl Salts.* R. PADMANABHAN AND S. K. KULKARNI JATKAR: *The Anomalous Rotatory Dispersion of l-β-Pinene—Part I.* B. B. DEY AND T. K. SRINIVASAN: *Studies in the Colarnine*

Series. Part IV.—5-Bromonarcotine, 5-Bromocotarnine, 5-Bromohydrocotarnine and 5-Bromonarceine and their Derivatives. DUHKHAHARAN CHAKRAVARTI: *Synthesis of Coumarins from Phenols and β-Ketonic Esters. Part III.—Use of Various Condensing Agents.* PHULDEO SAHAY VARMA AND K. S. VENKAT RAMAN: *Nitration. Part V.—Nitration of Monohalogen Derivatives of Xylenes.* PULIN BEHARI SARKAR: *The Chemistry of Jute-Lignin. Part VIII.—Methylation of Lignin.* PULIN BEHARI SARKAR: *The Chemistry of Jute-Lignin. Part IX.—Acetylation of Lignin.* S. M. MEHTA AND (MISS) OLIVE JOSEPH: *The Viscosity of Titanium Dioxide Sol in Presence of Electrolytes.* R. PADMANABHAN: *A Modified Photographic Method for Substances of Small Rotatory Dispersion.*

September 1935. K. VENKATA GIRI: *Studies in Salt Activation. Part II.—Influence of Salts on the Stability of Amylase.* M. M. RAM MOHAN RAO AND S. K. KULKARNI JATKAR: *The Heats of Transition of Triglycerides.* MAHADEO PRASAD GUPTA AND SIKHIBHUSHAN DUTT: *Dyes Derived from Acridic Acid.* SACHINDRA NATH ROY: *A New Volumetric Method for the Estimation of Lead.* RADHA RAMAN AGARWAL AND SIKHIBHUSHAN DUTT: *Chemical Examination of* Cuscuta reflexa, *Roxb. Part II.—The Constitution of Cuscutalin.* NRIPENDRA NATH CHATTERJEE: *Studies in Diphenyl Series. Part III.—A New Route to Phenanthrene.* M. A. HAMID GURCHARAN SINGH AND H. B. DUNNICLIFF: *The Action of Hydrogen Sulphide on the Chromates of Hydrogen, Ammonium, Sodium and Potassium.* RANAJIT GHOSH: *Synthesis of Hexahydro-α-Coumaranone.* B. B. DEY AND (MISS) P. LAKSHMI KANTAM: *Studies in the Cotarnine Series. Part V.—Condensation of Cotarnine with Aromatic Nitro-Aldehydes.* HARISH CHANDRA GOSWAMI AND PULIN BEHARI SARKAR: *On the Triple Nitrites of the Rare Earths and a New Micro-Test for Cæsium.* K. N. KAUL AND G. S. AHLUWALIA: *Action of Cotarnine and o-Nitrobenzaldehyde.* U. S. KRISHNA RAO AND B. L. MANJUNATH: *On the Supposed Occurrence of Acids with Uneven Number of Carbon Atoms in Vegetable Oils and Fats. Part II.—The Acid Fraction of Mean M.W.* 354 *from the Seeds of* Butea frondosa, *Roxb.* JAGRAJ BEHARI LAL: *Metallic Uranium in Organic Synthesis—Part II.* PRIYADA RANJAN RAY AND HARIBOLA SAHA: *A Short Note on the Chromium Biguanide Complexes.* DUHKHAHARAN CHAKRAVARTI AND BAIDYANATH GHOSH: *Synthesis of Coumarins from Phenols and β-Ketonic Esters. Part IV.—Coumarins from 4-Chloro and 2-Nitroresorcins.* HIRENDRA NATH DASGUPTA: *Heterocyclic Compounds containing Arsenic in the Ring—A Preliminary Note.*

The Indian Botanical Society:

September 1935. T. EKAMBARAM AND I. M. RAO: *Studies in Absorption and Respiration—II.* R. E. COOPER AND S. A. PASHA: *The Osmotic Pressure and the H-Ion Concentration of Sea-Weeds in Relation to those of Sea-Water.* S. C. DIXIT: *The Charophytes of the Bombay Presidency.* J. F. R. D'ALMEIDA: *On the Occurrence of* Gymnogramme calomelanos *Kaulf. in India.*

October 1935. R. H. DASTUR AND M. R. RAUT: *Carbohydrate Nitrogen Ratio of the Shoots of Some Tropical Trees.* P. ABRAHAM: *Occurrence of Extracapellary Ovules on the Floral Axis in Cotton.* A. B. SARAN: *The Effect of Wounding on Respiration in the Starving Leaves of* Aralia guilfuylei. D. B. MUKHERJEE: *Notes on a Collection of Plants from Mahendragiri.* T. C. N. SINGH: *Notes on the Teratology of Certain Indian Plants—VIII.* P. MISRA: *On the Peg of the Seedlings of* Cucurbita maxima *Duchesne.* B. N. SARKAR: *Note on the Movements of* Basella cordifolia *Lamk.* M. B. RAIZADA: *Recently introduced or otherwise imperfectly known plants from the Upper Gangetic Plain.* A. C. JOSHI: *Number of Chromosomes in* Sauvda fruticosa *Forsk.*

Industrial Outlook.

Fermentation of Molasses: Use of Pure Yeast Acclimatised to Antiseptic.

THE fermentation process with pure yeast is different from that with ordinary yeast because one knows when it commences and when it ends. It is a logical operation—almost mathematical.

For each vat of fermentation the leaven is changed so that the operation is always commenced with vigorous pure yeast. It is easy to understand that in this condition, the bacteria which are in the molasses are entirely subordinate to the yeast. This factor is more marked because pure yeast can tolerate large doses of antiseptics in the special apparatus, whereas the bacteria are completely paralysed by the antiseptics in the apparatus and in the large vats of fermentation. Similarly, if any mistakes occur during the operation of the yeast-apparatus or during its sterilisation, these are negligible owing to the action of the antiseptics.

Yeast which is continually changed enters the fermentation room with the maximum of strength and of diastatic power. The inversion of saccharose is effected in a short period and the transformation of the glucose into alcohol is complete.

The apparatus is so arranged that it is possible to clean it thoroughly twice a day without interruption of the process. This is not possible with the ordinary method of pure yeast culture.

A recent process developed by a French firm adapts laboratory methods of pure yeast culture for industrial purposes, and prevents the "negative phenomena" which up to now have paralysed its development.

DESCRIPTION OF PURE YEAST APPARATUS.

The pure yeast apparatus has an auxiliary equipment which supplies it with a current of purified air.

Supply of pure air which is an essential factor is secured with a pump which sucks air from above the roof of the distillery, and sends it into a filter of steel sheets filled with salycilic-cottonwool. Below the filter is placed a washer, two-thirds of which is filled with clean stones to distribute the air in the antiseptic liquid, kept in the apparatus.

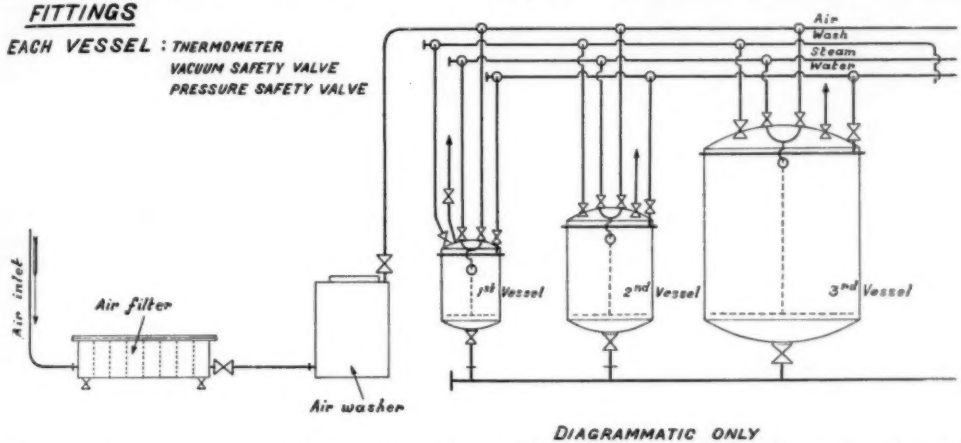
Basins for Culture.—Three basins are available for the culture. They are made of red-copper, tinned inside and have a capacity of 22, 55 and 330 gallons. As each of the three basins must be sterilised, aerated, cooled and connected with each other, they are fitted with 4 sets of pipes. Each basin is fitted with a pipe to convey the sterilised air, and a coil to carry either steam for sterilisation or water for cooling.

On the top of each basin is a manhole, a pipe with a valve for the escape of the gases, and two safety valves. A thermometer fitted to each apparatus enables the variations in temperature to be watched.

The basins are connected with each other at the bottom by a pipe which can serve (1) as an outlet for the yeast, (2) as an inlet for the wash, (3) for cleaning the apparatus, and (4) as an inlet for water and steam. The piping can be sterilised completely in an easy manner.

Each basin is fitted with two cocks for withdrawing samples, with a view to watching the fermentation.

It is easy to visualise with the help of the accompanying diagram how this equipment (manufactured by Ateliers Pingris and Mollet Fontaine Reunis, Lille, France) is operated to furnish a steady supply of pure yeast by progressive multiplication in the three basins.



DIAGRAMMATIC ONLY

The high content of the antiseptic and the strength of the yeast permits of the stoppage of the development of bacteria until the vat is filled. During this period, the yeast apparatus continues to furnish fresh yeast and every 14 hours a pitch tank will be ready for a new fermentation.

If the yeast apparatus is correctly operated, it can run continuously without changing the yeast for a period of 3 to 4 months, and the efficiency from actual experience in India, reaches more than 90 per cent. of the theoretical.

Ninth Conference of the Indian Mathematical Society.

THE Editor, *Mathematics Student*, writes:

We beg to remind our readers of the Ninth Conference of the Indian Mathematical Society which meets at Delhi at the invitation of the Delhi University between the 19th and 21st of December (both inclusive) this year. It is hoped that a large and representative body of members will participate and ensure its success. Those who intend attending the Conference are requested to communicate with Dr. Ram Behari, M.A., Ph.D., Professor, St. Stephen's College, Delhi, who is the Chairman of the Local Committee. As the programme will soon be printed, it is requested that abstracts of papers intended for the Conference be sent to Dr. A. Narasinga Rao, Professor of Mathematics, Annamalai University, Annamalainagar, without delay.

Reviews.

THE USE AND MISUSE OF LAND. By R. Maclagan Gorrie. (Oxford Forestry Memoirs, No. 19, 1935.) Pp. 80. (The Clarendon Press, Oxford.)

It was long the fashion for the Agriculturist to think of the Forester as his natural enemy. This view, born of ignorance, is gradually disappearing but not yet dead. There is as yet, however, no widespread appreciation and occasionally not even recognition that sound Forestry instead of being incompatible with flourishing Agriculture, is an important and even integral part of it. The Forester and the Agriculturist are both vitally interested in the quality and quantity of their common basic commodity—the Soil. But, strangely enough, books which take a long-term view of Forestry and correlate its fundamental bearing to soil are all too few. It is for this reason that Dr. Gorrie's interesting Memoir is to be welcomed.

The book deals primarily with grazing and its relation to Soil Erosion. Indeed, the author who at first set out to trace "The Correlation of Erosion Damage and Grazing in Forest Lands" subsequently enlarged the scope of his enquiry because he felt that "if land as a whole could be put to its best uses.....the menace of overgrazing would automatically disappear". The value of Dr. Gorrie's book lies as much in this significant standpoint of the author as in the suggested solutions of the problem. Much the greater part of the data in the book relating to Land Erosion are from the United States and some at least of the lines of attack interest us in India as showing how the problems are tackled elsewhere rather than as how they should be here. Such concepts as "Palatability" of fodder to livestock, "Forage Factor" (defined as, Average Type Palatability × Average Type Density) dealt at some length in the Memoir are of little more than academic interest to the Indian student.

The volume opens with a fascinating account of "Forestry as a Factor in Land Management". A survey of some aspects of grazing leads the author to a consideration of Grazing as a primary cause of Soil Erosion. The control of stream flow is then discussed and there is a separate chapter on "Farm Erosion and its Control". The title of the last chapter "Public and Private Control of Land" almost suggests a discussion of socio-economic theories of land ownership of which, however, the author steers clear and gives short accounts of Erosion Control and Regional Land Planning as practised in the United States.

The use of the expressions "concave upwards" and "convex upwards" in describing Soil Profiles (p. 38) is a little jarring. The units employed in the tables are not always happy. Thus land erosion in Table I (p. 50) is expressed in "cu. yds. per sq. mile" while in Table II (p. 51) the soil loss is quoted in "tons per acre". A couple of Americanisms, "on to which" (p.74) and "Alinement" (p. 76) are noticeable.

A bibliographic list is given at the end of each chapter. But for a semi-jocular reference to Wang's "Grundriss der Wildbachverbauung" in the text (p. 49) and a reference to Cabianca's paper (p. 60), the selection ignores the work of the Continental schools of thought. A few appropriate references to the pioneer work of the great German and specially Russian pedologists would very considerably add to the value of the Bibliography.

The Memoir should be read by every one interested in the intelligent utilisation of land.

EMMENNAR.

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THREE PHILOSOPHERS. By W. R. Aykroyd. (William Heinemann, Ltd., London, 1935.) Pp. 227. Price 10*s*. 6*d*.

In the history of every nation there are periodically recurring moments when the nation wakens to a national consciousness. To the French people such a historic moment came, when the public discovered the injustice of the verdict of the sanguinary Tribunal of the Revolution, to guillotine Lavoisier. The story of the life and work of this pioneer of modern chemistry makes fascinating reading to which a pathetic turn is given by the exceptionally tragic circumstances that attended his end.

In the present volume, the author gives primarily a biography of Lavoisier to which are added the lives of the two eminent English scientists, Priestley and Cavendish. These latter two were Lavoisier's contemporaries and rivals in the field of science. As an excuse for the inclusion of these two biographical sketches when his main purpose seems to be to lay bare the rather unfamiliar

life-history of the French scientist, the author suggests that the achievements of no scientific worker can be studied with advantage without reference to those of his contemporaries whose work no doubt must dovetail with his own. This method is amply justified in as much as certain obscure points in regard to claims for priority of discovery raised by some biographers have been set at rest. The lives of the three great figures of modern science are pursued on parallel lines and wherever appropriate, their attainments as men and scientific workers are critically compared.

Lavoisier came from the solid middle class and had a good start in life. The family traditions would have shaped out an entirely different course for young Lavoisier, but his native genius triumphed and made him elect a scientific career. To him the attainment of scientific distinction was of paramount importance. His chief claim to our remembrance and admiration rests on the laurels he won in the field of science, though he rendered signal service to the state and society as an administrator of the Revenue Farm and as the able head of several commissions on social reform. To Priestley all the advantages which birth and wealth could give were denied by nature, and his early education took place in an atmosphere of dissenterism. So it is small wonder that his mental horizon was dominated by theology in the light of which all other considerations were unworthy of serious attention. The scientific career of Priestley was spasmodic and all his major discoveries were made in fits and starts. Scientific research to him was a source of profound amusement that could fitly occupy his leisure. Like Saul, who came upon a kingdom when he was seeking his father's asses, he stumbled upon great discoveries. The history of the social life and scientific career of Henry Cavendish is a study in contrasts. Although coming of an aristocratic stock he inherited none of the gifts that go to make men successful in society. Aversion to society and in particular to women, was but one among a host of curious sadistic tendencies. Strange tales are current of how he avoided all contact with women. Coupled with this remarkable psychosis was an intellect, which, to say the least, was of the first rank. Science was the one light that relieved the genuine gloom of this singular mind.

Apart from the biographical interest in the book the serious student of chemistry finds much food for thought. The refutation of the infamous theory of "phlogiston", which was obstructing the progress of chemistry for more than a century, by Lavoisier and unwittingly by Priestley himself has been developed at length in its historical and logical sequence. Another topic of general interest is the establishment of the composition of water by Cavendish, which is all the more striking as nothing like scientific technique existed then. Lavoisier was the first to study metabolism and related phenomena which have culminated in the vast and fruitful science of Nutrition.

The background of these biographies is undoubtedly the troubled times of the latter half of the eighteenth century. The lives of at least two of the personages are coloured by the French Revolution, and unfortunately one of them was victimised by its bloody tyranny. The passages where the Reign of Terror is depicted, speak eloquently of the author's abilities as a descriptive writer. The mock trial of the Revenue Farmers before the Revolutionary Judges is at once vivid and pathetic in the extreme.

Like many a great man Lavoisier owed in great measure his success to the unremitting devotion of his wife. Any sketch of his life would be incomplete without a reference to Marie-Annés who was his collaborator and inspirer. The author has done her ample justice by clearly indicating the nature of the co-operation which subsisted between them, which in great measure contributed to their joint successes. In the closing chapters of the book her history after the death of Lavoisier is narrated which serves to vindicate her character though she accepted the suit of the Count Rumford.

Speaking of the style of the author we admit without hesitation, that, though he is a specialist in a highly technical branch of science, his power of exposition may well be coveted by any literary man. The narrative is very lucid and is enlivened by anecdotes relating to incidents in the lives of these three scientists. English writers have meted out scant justice to Lavoisier who has been accused of appropriating others' discoveries to his credit. But in Dr. Aykroyd the French Chemist finds an enthusiastic champion.

Of the essential accomplishments for good citizenship, one of the most necessary factors

is perhaps the development of the historical sense. Among those that foster the cultivation of this sense most are the biographies of great men who have contributed to the public weal. To all those who wish to make a beginning in this direction Dr. Aykroyd's *Three Philosophers* is eminently suitable. The book provides the necessary background and the materials to build upon. The multiplication of such books will obviate the keenly felt desideratum as the literature of this kind is none too profuse. Meanwhile we extend our most cordial congratulations to the author for having won this signal distinction in the field of the professional historian.

C. N. R. R.

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HEREDITY AND THE ASCENT OF MAN. By C. C. Hurst, Cambridge. (The University Press, 1935.) Pp. ix+136. Price 3*s*. 6*d*. net.

Human history is in reality only a special aspect of natural history, dealing with the succession of events having to do with the human species. It is continually asked, what has man been doing through the long ages of his existence? The answer is furnished in part by the answer to the even more fascinating question—what will he become in the ages to come? Modern research in biology has taught us that minute particles of living matter with definite composition pass unchanged from generation to generation. We have learnt further that the human individual is extremely complex and is made up of materials, which while deriving their salient traits from ancestral germ-plasm are arranged in new ways so that it is rarely possible for two individuals to come into the world with the same inheritance of living stuff. In the fifties of the last century Gregor Mendel, an Austrian abbot, discovered the fundamental unit of life and mind the 'gene', but like many a great discovery it was completely ignored by Mendel's contemporaries. It was not until the beginning of the present century that scientists accorded to this discovery full recognition, for want of which biologists found themselves confronted by well nigh insurmountable difficulties. Since then the progress of genetics has been both steady and considerable. Among the experiments whose work has contributed most to this progress, the name of Dr. Hurst stands pre-eminent, whose work *Experiments in Geneties* has been considered to be a classic in the field. The present book is a sequel to this more elaborate work, and is a very popular epitome of the recent work and achievements of the geneticists.

The book is devoted to a description of the fundamental unit of life and mind—the gene—which is the determining factor in the behaviour of all living organisms. Authority is implicit in this narration inasmuch as the author is a man of science and of recognised authority. The enthralling story of the evolution of living things is told in plain and simple terms making it intelligible to the lay reader. An unique feature of the book is that interesting speculation is set forth concerning the future of the human race. The author by a consideration of experimental facts comes to the universally interesting conclusion that the genetical work of the past few years may bestow freedom and power on man to shape his destiny. This sounds in striking contrast to the classical saying that "there is a Divinity that shapes our ends". Another thesis of especial interest to the statesman is that the nation which adopts scientific methods of race improvement will inherit the earth. Recent events in countries such as Germany, Turkey and Italy, under dictators, have at least in part justified this claim.

It is impossible to emphasise the importance of genetical science to the horticulturist and the breeder, but the aim of the author in this book seems to be to attract the man-in-the-street whose interest in this subject must be aroused and inspired to pursue the study at greater length. It will not be too much to expect that the volume will make an instant appeal to all those who wish to acquaint themselves with what is going on in one of the most rapidly progressing branches of biological research which has done so much to change the order from natural selection to human selection and enabled man to take a hand in creative evolution.

C. N. R. R.

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COSMIC RADIATION. By Prof. P. M. S. Blackett. Part I—General Survey. 22 pages. Price 10 *fr*. Part II.—The Wilson Cloud Chamber Method. 24 pages. Price 8 *fr*. Part III.—The Effect of the Earth's Magnetic Field. 19 pages. Price 7 *fr*. Part IV.—The Loss of Energy by Ionisation. 17 pages. Price 10 *fr*. (Actualités Scientifiques et Industrielles. Hermann et Cie, 6, Rue de la Sorbonne, Paris.)

These papers were read before the four conferences on Cosmic Radiation, held in

May 1934 by the College of France in Paris, and have been printed practically as read. It is unfortunate that they were not published more than a year earlier. They contain in concise form an account of the main lines of development of our knowledge of cosmic ray phenomena and would therefore prove valuable to those who wish to view this field through the eyes of one who has had a share in its development.

The introduction to the subject in the first paper begins with a quotation from an enthusiast who wrote without exaggeration: "Cosmic Radiation is a subject unique in modern physics, in the minuteness of the phenomena, the delicacy of observations, the adventurous expeditions of the observers, the subtlety of the analyses and the grandeur of the deductions."

After a very brief historical statement, there follows a correspondingly condensed account of cosmic ray intensities at various depths below the top of the atmosphere and under water in deep lakes, as measured by ionisation chamber methods. Intensity variations with time; geomagnetic latitude and longitude and their significance are discussed. It is pointed out that these data leave little room for doubt that the primary rays are electrically charged particles. Results obtained by means of counter-tube controlled cloud chambers are discussed in a little more detail and the paper ends with an all too brief consideration of the origin of this mysterious radiation.

The second paper should be of special value to those who wish to do experimental work with cloud-chamber apparatus. It begins with a discussion of the formation of tracks, their width, number of ions per unit length, and other matters. A few details of construction of apparatus used by the author are given. The latter half of this paper is devoted to a discussion of the production of "showers" and "bursts", investigated chiefly by means of Geiger-Muller counter-tubes.

The author shows that observations are best explained by assuming that electrically charged primary rays of high energy, in their passage through matter, produce at intervals, along their paths, a non-ionising radiation of the gamma-ray type, which in turn is absorbed with the emission of positive and negative electrons which ionise all along their paths. The production of a relatively small number of these tertiary rays at one time is called a shower but, occasionally as a result of some catastrophic process, millions of these tertiary rays are produced and this is spoken of as a "burst". It is not clear that these two phenomena are of exactly the same type. In all cases it seems certain that practically all the energy involved in these phenomena comes from the primary particles.

The subject-matter of the third paper is especially important because it shows very conclusively that the primary radiation consists chiefly of electrically charged particles, most of which are positive. The author deals at some length with the theoretical work of Störmer and of Lemaitre and Vallarta, *i.e.*, with the motion of high-speed electrons and protons in the magnetic field of a di-pole, the earth. Observational results, in the light of theory, indicate clearly that only a small percentage at most, of the softer portion of the penetrating radiation can possibly be of terrestrial origin, while all of the harder rays must come from beyond the confines of our own galactic system. Thus the term "cosmic radiation" seems to be fully justified.

The fourth paper deals with the various processes by which the energy of a cosmic ray particle is dissipated while passing through matter. The cosmic ray may (*a*) cause excitation or ionisation by passing near an electron in matter; or (*b*) directly hit an electron giving rise to a secondary high energy ray; or (*c*) make a direct collision with an atomic nucleus, resulting in the production of many high-energy photons, as mentioned above, and probably other complications.

For process (*c*), the effective area of cross section is only a small fraction of the area of the nucleus of the atom concerned, while in the absorption of the photons, the effective area is proportional to the atomic number, which in the case of heavy elements is many times greater than the area of cross-section of the nuclei.

In such papers as these it is of course impossible to give details of construction and use for the many types of apparatus mentioned. For such information and indeed for any serious study of the subject a bibliography listing more than a hundred well-selected papers is appended. Another worthwhile feature of this work is a set of fifteen excellent reproductions of some remarkable cloud-chamber photographs by C. D. Anderson and of several by the author.

J. M. BENADE.

LES SPECTRES DES NEBULEUSES GAZEUSES. Par P. Swings. (Actualités Scientifiques et Industrielles. No. 241, 1935.) Pp. 1–26 Prix. 10 *fr.*

This is perhaps one of the smallest volumes in the Actualités collection running to twenty-six pages only out of which 15 pages are devoted to a table, two appendices and the title pages. It is remarkable that in the remaining short space of 11 pages the author should be able to present such a clear and up-to-date account of the subject. This has been made possible because in the first place the author himself has done, in collaboration with B. Edlén, very important work in this field and in the second place there already existed the beautiful article of Bowen (*Ap. J.* 1935, 81, 1) giving a synthesis of the ideas on the subject.

The author treats fully the mechanism of excitation consisting of primary process of ionisation by absorption of stellar radiation and the secondary processes of ionisation by secondary radiation, excitation by the same and excitation by secondary electrons. On the other hand, the treatment of that part of the subject dealing with chemical composition must certainly be considered to be inadequate although the author has given a resumé on p. 16. It might be remarked, in passing, that this resumé reads almost like a literal translation of the first paragraph on page 16 of Bowen's article mentioned above.

B. S. M.

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DE'NOMBREMENTS D'E'TOILES. Par H. Mineur. (Actualités Scientifiques et Industrielles. No. 225. 1935.) Pp. 1–56. Prix. 15 *fr.*

This volume forms, as the author states in the preface, an indispensable complement to the volume on the measurement of positions and magnitudes of stars which has already been reviewed in these columns (*Curr. Sci.*, 1934, **3**, 223). The attempt to condense in a short space the very latest work done in the field has resulted in making the treatment necessarily sketchy and the material is not presented in a logical sequence as was done in the author's volume on " Photographie Stellaire ". There is neither a table of contents nor an index nor a bibliography.

The work is, however, quite authoritative and there are no errors of a serious nature. The large number of tables and graphs interspersed throughout the volume adds much to the clarity of the exposition. Of particular interest is the representation, by means of formulæ, of the number denoting stars more brilliant than magnitude m, as based on the work of Chapman and Melotte, Van Rhijn and Seares. As a preliminary to the actual subject of star counts, the author has briefly reviewed the principal star catalogues and charts and assessed their relative importance from the point of view of Stellar Statistics. Importance has rightly been given to the Harvard photometric sequences, this being the source on which the author mainly relies.

This is an indispensable book for an astronomer, theoretical or practical.

B. S. M.

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PHENOMENES D'INTEGRATION DANS LES CULTURES DES TISSUS. By B. Ephrussi. (Actualités Scientifiques et Industrielles. Hermann & Co., Paris, 1935.) Price 8 *fr.*

Tissue Culture, undertaken mainly by workers on Cancer Research, has, in practice, involved the solution of many problems of General Biology. One such problem, as Vogt puts it, is " the individuality of cellular culture..... After several transplantations what type of formation is represented by a culture of fibroblasts?..... Is it a Unity like that of the whole organism or a part of the organism? " We venture to paraphrase it in common language as follows: Is it (the culture of tissue cells after several transplantations or passages) a chip of some block or are there as many blocks as there are chips or cells? Albert Fischer, the author of the best book on Tissue Culture, so well qualified to speak on such a problem, says in one of his papers, " The transplanted tissue obeys all the laws of physiological integrity..... We are here dealing with a partial organism and not with cellular organisms." The reasons for such an opinion have been based on certain differentiations which appear among cells on culturing a tissue. For example, the epithelium of the Thyroid begins to form the colloidal substance only in the centre while the cells on the periphery of the same culture continue to multiply undifferentiated. M. Ephrussi rightly compares a culture of tissue to an organism, for cells sometimes show division of labour even though the main function leading to the division of labour may not be apparent; he calls this oriented heterogeneity. He summarises the following points of identity between the

culture of tissue cells and an organism as a whole: (1) The tendency towards a definite shape. (2) The limit of sub-division (for single cells of tissue do not grow). (3) The power of regeneration which naturally regulates the shape. (4) Oriented heterogeneity. M. Ephrussi further finds two problems common between the science of Tissue Culture and General Biology: (1) What limits the growth of a tissue in culture? and (2) What determines the development of a cell? That there is a regulating factor inherent in a culture of tissue is inferred by the presence of a similar substance in a colony of Vorticella as previously shown by the renowned French Biologist, Faure Fremier, under whose editorship the present brochure has been issued. Such a substance, although hypothetical at present, is probably also found in an egg where it regulates the growth of the embryo. M. Brachet has called it "Genetine". M. Ephrussi has given a clear exposition of the subject within 22 pages of printed matter using some 10 diagrammatic figures for illustrating the important points. For the modest price of 8 francs nothing more could be expected but many a reader would have welcomed a longer essay perhaps with some microphotographic illustrations which would have given a more realistic representation of the phenomenon discussed so ably by the author. The subject appears to be of very recent origin, for no paper in the bibliography dates earlier than 1922.

S. M.

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HEAT. By Hutchinson. (University Tutorial Press, Ltd., London.) Pp. 284. Price 3*s*. 6*d*.

This is an excellent work by a well-known author and fits in admirably with the Intermediate syllabus of Indian Universities. The chapter on "Radiation" is the only chapter where the author could have adopted a fuller treatment by the addition of the "Theory of Exchanges" and Richie's experiment.

A historical background is provided throughout the book by detailed description of classical experiments. The utility of the book is greatly enhanced by the mention of all the practical applications of heat in industries and engineering. Heat engines have received particular attention in the last chapter.

The worked and unworked examples are as interesting as they are varied in type. Solutions to the examples are, unfortunately, omitted and would be a welcome addition to the book.

One cannot help wishing that the cover of a book, whose get-up in other respects is excellent, were of a different colour. The bright orange cover "strikes" one in the eye. Would not a light green or blue be more suitable for a study?

P. A. MADHAVA RAO.

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ORGANIC SYNTHESES. Vol. XV. Edited by W. H. Carothers. (Messrs. Chapman & Hall, London, 1935.) Price 8*s*. 6*d*. net.

The book under review is the fifteenth member of the series of publications entitled "Organic Syntheses". The present one contains description of usefully workable methods of thirty different preparations. The inclusion of substances like 5 : 5-dimethyldihydroresorcin, diazomethane, 2 : 4-dinitroaniline, *p*-iodophenol, 1-methyl-2-pyridone, etc. and an experiment describing the preparation of anhydrous hydrogen bromide, obtainable continuously for hours, make the book quite useful. Amongst the types of reactions dealt with in the present volume are to be found examples of (1) addition of hydrocyanic acid to a ketone, (2) substitution reactions, (3) reduction with tin and hydrochloric acid, (4) Grignard's reaction, (5) malonic ester condensation, (6) decarboxylation with concentrated alkali at high temperature, (7) halogenation with halogen acids, and (8) oxidation with selenium oxide. The get-up of the book and the disposition of the contents are exactly as in the previous volumes.

P. C. GUHA.

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LABORATORY MANUAL OF PHYSIOLOGICAL CHEMISTRY. By Prof. Meyer Bodansky and Marion Fay. Third Edition. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London, 1935.) Pp. vii+274. Price 10*s*. net.

This is the laboratory companion to Professor Bodansky's well-known *Introduction to Physiological Chemistry* (*cf*. review in *Current Science*, 1935, **3**, 318) and the latter should be consulted at every stage to understand the bearing and significance of the experiments dealt with. As an elementary laboratory manual useful to students preparing for a degree in Medicine, the book serves a real need. It comprises both qualitative and quantitative experiments, systematically arranged. The subjects dealt

with are few, but vital and within the limits imposed by the size of the manual; the authors have succeeded in placing before the readers, a comprehensive array of the salient features of physiological chemistry. While the book cannot lay claim for completeness, it serves as an excellent introduction and if supplemented by collateral reading of easily accessible literature with the assistance of the references cited throughout the book, the student cannot fail to obtain a working knowledge of the subject.

The get-up of the book is excellent and leaves nothing to be desired. We are confident that the revised edition will receive a warm reception.

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INSECT PHYSIOLOGY. By V. B. Wigglesworth. (Methuen & Co., London.) Pp. viii + 134 with 13 Illustrations. 1934. Price 3*s.* 6*d.*

This little book maintains the high standard reached by other monographs on biological subjects published by Methuen & Co., Ltd. It will be welcomed by the agricultural and medical professions and will be of great value to students of general zoology. The general physiology of the group of Insects which are the most numerous in species and the most varied in structure and habits, is apt to be observed by the practically endless specializations of these animals, but the author has retained only the material points, linking all the general factors into a single system, in illustration of his theme.

Though the early scientists like Hooke, Malpighi and others have studied the morphology of insects and have given us correct and valuable information about their physiology, the subject did not receive further attention nor any impetus till entomologists were confronted with the ravages caused by the insects in the spheres of agriculture and public health. Subjects like responses to stimuli, reactions to parasites, acclimatisation and the action of toxic sprays and gases upon these, have engaged the attention of economic entomologists within recent years. We, therefore, congratulate Dr. Wigglesworth and welcome his largely illustrated monograph in which the author says that "the sketch which follows is based on the study of nearly 2,000 publications, and on a certain amount of original work".

The first chapter deals with the integument and it is very well known that a large amount of insect physiology depends upon the nature of its cuticle. The cuticle which consists of thin epi- and a thick endo-cuticle is shed from time to time. The unimpregnated endocuticle is very elastic and this is proved by the fact that the first stage larva of Rhodnius can receive into its abdomen more than 12 times its own weight of blood. During moulting, a large part of the cuticle is dissolved; the endocuticle when unimpregnated with cuticulin undergoes dissolution, when the epicuticle remains untouched. Possibly this digestion of the cuticle is brought about by the secretion of enzymes (a chitinase or protease) by the dermal glands into the moulting fluid present between the new and old cuticle. The epicuticle is torn by the pressure of the blood. Chapters II and III deal with the respiratory and circulatory systems. The diffusion theory of insect respiration is briefly described and an account of the respiration in aquatic forms like Hydrophilus, Dytiscus (metapneustic respiration) and Notonecta is given, and among parasites mention is also made of the aquatic larvæ of Donacia possessing special siphons which are inserted into the air-containing tubes of aquatic plants, and thus remain submerged permanently. The wounds in many insects are merely closed by a plug of cells and the blood does not clot in that region. The blood-cells or hæmatocytes are phagocytic and accumulate on the sides of the dorsal blood-vessel forming phagocytic organs.

In the chapters on digestion and excretion, besides giving important and interesting information regarding salivary glands, the author has given excellent description of digestive enzymes, Malpighian tubules, the holocrine and merocrine types of secretion. The former is a cellular disintegration to form the juice while the latter is merely a secretion from the epithelium.

The next two chapters deal with nutrition and metabolism, and reproduction and growth. The importance of symbiotic organisms is discussed in insects like Cimex, Glossina and Pediculus. With regard to the subject of metamorphosis, it is believed that this is initiated by a harmone which is different from the one responsible for moulting.

The last chapter gives an account of the nervous system, sense organs and behaviour. There is a large list of references given at the end of the book so that students requiring detailed information may refer to the original papers. The get-up of the book

is neat and attractive and we have no doubt that it will be appreciated by the scientific workers for whom it is intended.

L. S. R.

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HELMINTH PARASITES OF THE DOMESTICATED ANIMALS IN INDIA. By G. D. Bhalerao. (Scientific Monograph No. 6 of the Imperial Council of Agricultural Research.)

The study of helminthology has, in recent years, revealed its importance not only in medicine and public health, but also in veterinary and agricultural sciences. Unfortunately this branch of science has, till recently, been neglected in India. Mr. Bhalerao's Monograph on the "Helminth Parasites of Domesticated Animals in India" has adequately put forward its claims in veterinary science and is a valuable asset to the helminthologists and veterinarians alike. The aim of the monograph is to provide a collective account of the helminth parasites of our common domestic animals and to facilitate their identifications. Each helminth group—Trematoda, Cestoda, Nematoda and Acanthocephala—is considered separately, beginning in a general way with the morphology and life-history, followed by a systematic account of the group under review. Elaborate keys for the identification of the parasites belonging to each group form very useful part of the work. The descriptions, though concise, are suitably illustrated by clear diagrams, many of which are claimed to be original. The bibliography given at the end of the book is exhaustive and renders the volume of service even to advanced workers. The author has successfully achieved his object and the work compares favourably with any other in the field.

No work of this kind can be perfect in every way and there is always a danger of its becoming out of date, even prior to its publication, especially when continued research is daily adding new forms to the helminth fauna. There appear to have been certain omissions and unfortunate errors in this volume. The author has been rather modest in omitting his important forms described in recent years. In the interest of the subject, these and certain others described by other authors from India ought to have been included in the book. Mention of the presence of receptaculum seminis in the family Psilostomidæ is rather curious, as its absence has been emphasised in many standard works (*vide* Führmann in Kükenthal's *Handbuch der Zoologie*). There are some slips as well and these though trivial, are blemishes in an otherwise admirable piece of work.

The general get-up of the book is nice and the paper used is good. The book is particularly welcome as it comes from the Research Staff of the Imperial Institute of Veterinary Research, Muktesar, where most of the officers of the Veterinary Department now complete their training. Mr. Bhalerao is, therefore, to be congratulated on this successful venture of a zoologist. The book is the first of its kind from India and will undoubtedly well serve the purpose intended. It should meet the requirements of both the student and the practising veterinarian, and would, besides, form a useful addition to the zoological libraries.

G. S. T.

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FUNDAMENTAL PHYSICAL PROPERTIES OF LAC—PART I. MECHANICAL PROPERTIES. By Lal C. Verman. (Technical Paper No. 3. London Shellac Research Bureau.) Pp. 28.

This neat brochure heralds the publication of a series of four dealing with various aspects of the Fundamental Physical Properties of Lac, *viz.*, Mechanical Properties, Thermal Properties, Electrical Properties and Optical Properties. It was pointed out by Mr. Gibson, sometime ago, that, among other things, compilation and publication of exact data on the Physical, Chemical and Mechanical Properties of Shellac, with special reference to use in industrial processes, would go a long way to consolidate the position of lac as a raw material in industry; Dr. Lal C. Verman has taken great pains to collect and collate the floating facts and present them in such a concise form for ready reference. After a brief outline of the methods and their limitations, values are given for the specific gravity of shellac, film-hardness, adhesive strength, ultimate tensile strength and modulus of elasticity of various types of shellac and shellac compositions. Wherever possible the corresponding values for other natural and synthetic products are also given for comparison.

A perusal of this booklet brings to light certain striking properties of lac which can be turned to commercial exploitation. The removal of the wax from lac seriously impairs the scratch-hardness and abrasion resistance of shellac films, and the author's own work indicates that the natural wax is far superior to added plasticisers in conferring hardness and especially abrasion resistance

to shellac films. It has been clearly pointed out that the hardness of the film depends on the nature of the base to which it is attached and the subsequent baking. Another remarkable property of lac brought into strong relief is that its adhesive quality is something enormous compared with fish glue and gelatin, the drying period being relatively negligible at that. In spite of this the film produced from shellac varnish can be "flatted" by sand-paper. An adequate bibliography at the end considerably enhances the usefulness of this brochure.

This publication is all the more welcome at this juncture when lac is faced with a crisis. By bringing to the fore the outstanding qualities of lac, it may help the lac industry to hold its own against the onrush of synthetic products. It is hoped that, ere long, the other parts also will come in print.

A. V. S.

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INDIAN SUGAR INDUSTRY (1935 ANNUAL). By M. P. Gandhi, Secretary, Indian Sugar Mills Association; Secretary, Indian Chamber of Commerce, Calcutta. (G. N. Mitra of Messrs. Book Co., Ltd., 4/3 B, College Square, Calcutta.) Pp. xvi+57+22. Price Rs. 2–4–0 (postage extra). Foreign 7*s*. 6*d*.

At the time when the Indian Sugar Industry is making rapid strides of advance under the Government's protection policy with all its beneficent influence on the agriculture of the country, this publication by Mr. M. P. Gandhi must be of immense interest to industrialists as well as to the general public. The author has presented briefly all sides of the industry and its inherent problems. The earlier part of the book contains tables of all the necessary data about production, exports, imports, costs, consumption and many other pertinent topics. The main text confines itself to a detailed explanation of practically the same topics with the author's views and arguments. The reader has herein an opportunity of knowing a short history of this important industry, its present position and the future possibilities.

The fifteen tables inserted in the book are useful as permanent references because they include besides the figures for the year under consideration those for several of the preceding years and also here and there estimates for the coming years. The appendix contains an outline of world sugar industry with a special section on Java. The monograph ends with a very useful list of all the sugar factories in India.

For purposes of easy comparison quantities must be expressed in the same unit, for example, as tons or as maunds and though it is appropriate to use both the units it will make comparison of data more difficult. We find also different ways of numeration adopted even in one and the same table as for example in Section (9) of "The Indian Sugar Industry at a Glance" where the quantity of cane crushed is expressed as lakhs of tons and other quantities as millions of tons. Attention to these small details is bound to enhance the value and usefulness of the work.

It is hoped that the author undertakes this publication every year for the use of the public who are interested in the welfare of one of our important national industries.

G. G. R.

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CANDLE MANUFACTURE. By Professor Dr. N. N. Godbole, assisted by R. N. Mehta. (Benares Hindu University, Benares, 1935.) Pp. iv + 29. Price Rs. 2. Foreign 4*s*.

This small book of 29 pages embodies the practical experience of the authors in the industrial laboratories of the Benares Hindu University and also includes information collected elsewhere.

The first chapter presents a brief survey of the historical and economic aspects of the industry. The raw materials of the industry are described in the second chapter, which gives in addition an elementary idea of the process of the "splitting" of fats and hydrogenated oils. Auxiliary materials such as ceresine and bees-wax as well as the recently developed I-G waxes, and their assistance in the manufacturing process are indicated in the fourth chapter.

A short account of preparation of candle-wicks and the significance of the melting and congealing point of candle-material is followed up by a very brief description of the manufacturing process as carried out with modern machinery. Some hints are also given regarding the manufacture of fancy material such as coloured, medicated or perfumed candles.

The tables given in the appendix contain information concerning (1) size of wick and diameter of candle, (2) shape, size and weight, and (3) melting points of some types of candle-material.

It is hoped that this book will be read by all persons interested in candle manufacture.

UNIVERSITIES YEAR BOOK, 1935. Published for the Universities Bureau of the British Empire. By G. Bell & Sons, Ltd., London, 1935. Pp. xxxi+1057.

The latest edition of this well-known year book has all the merits of its predecessors, authoritative character, comprehensiveness and excellent get-up. First published in 1914, the Year Book has become more and more indispensable to the members of universities and colleges, government departments, clubs, school masters, etc., who find in it much information of interest regarding members of other universities, colleges, etc. The publication has been brought up-to-date and the arrangement of matter is so designed as to make ready reference possible and in this, considerable assistance is afforded by the excellent name and general indices.

Each section under Universities (of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India) comprises a directory of the officers and members of the staff of the universities, general information and reports of events of outstanding interest which occurred during the previous year. There are 31 appendices, which provide such varied information as professions and careers, post-graduate scholarships, centres of scientific and industrial research, etc. Considerable space is devoted to Indian universities not only in the earlier chapters, but also in the appendix. The publication is indispensable to all libraries where it will occupy an important place among reference volumes.

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LES ASSOCIATIONS BIOLOGIQUES AU POINT DE VUE MATHEMATIQUE. By M. Vito Volterra and M. Umbreto D'Ancona. Pp. 97, 28 Figs. (Actualités Scientifiques et Industrielles. Hermann & Co., Paris, 1935.) Price 20 *fr.*

This brochure is a guide to the study of the rise and fall of population among animals and lower organisms by the application of mathematics. The late E. F. Smith, the author of *Bacterial Diseases among Plants*, who has done more than any one else to increase our knowledge in this branch of science and as such deserves to be considered a great biologist, says in his book, "Nothing is more discouraging to the general reader than a book or paper full of mathematical formulæ." He further writes, "Biologists, for the most part, are very far from being able to express themselves after the manner of mathematicians. Their language and ours is unlike almost to mutual exclusion. If your liking for mathematics is second only to your love of biology, then you may study it as long as you feel inclined. You will be a kind of white blackbird among your fellow biologists but this need not disturb you since you will be able to do some things which they cannot do." If any ambitious biologist wishes to make himself such a "white blackbird", he cannot do better than start with the work of Volterra and D'Ancona under review for it gives as easy and simple an introduction to the subject as possible. Volterra's mathematical theory of the struggle of life has proved of such significance that it has offered others like Gause and Severtzoff material to elaborate on. Master of his field Volterra's treatment of the subject can hardly be surpassed in lucidity and selection. However, as the authors themselves state, their publication, on account of its small size, can hardly serve as anything more than a guide and they refer the interested reader to other literature in the bibliography. Here we note several serious omissions. E. Fischer's name occurs in the text on p. 82 but none of his papers is listed at the end of the book. At the University of Oslo, Prof. Hjort, collaborating with Drs. Ottstad and Klem, has made a mathematical analysis of yeast growth as a model of increase in population and applied this and similar results to study the fluctuating population of the whale. These three Norwegian scientists have published excellent "Essays on Population" in 1933 but no reference is made anywhere to thei work. Influenced by the application of mathematics to the study of insect epidemics, H. E. Prof. Escherich, the present Rector of the Munich University, has explained "The New Aspect of Forest Entomology", in *Forstwiss. Cen.*, 1930, Heft 12; while from his Institute Prof. Zwölfer has published several classical papers, among others a mathematical essay entitled, "The Theory of Insect Epidemics", *Biol. Zentr.*, 1930, Bd. **50**, Heft 12. These papers also appear conspicuous by their absence. Like most French books the publication under review is an inexpensive one and Messrs. Hermann & Co. have the readers' thanks at the fine get-up and the absence of all errata.

S. M.

The Structure of Metallic Coatings, Films and Surfaces.*

THE papers read at a symposium on this subject conducted by the Faraday Society and the discussions thereon appear in a special number of the *Transactions of the Faraday Society*. A number of well-known workers in this field have taken part and in all there are about thirty papers.

In Part I, Professor Finch and his collaborators have given a complete account of the study of surfaces by electron diffraction methods. Their paper surves as a valuable monograph for workers in this field. It is made quite clear that although there are still a few points to be cleared regarding the interpretation of experimental results, the method of electron-diffraction is probably the most powerful available for the study of surfaces. The evidence given by this method towards the clarification of the "vexed question" of the Beilby layer on polished surfaces is in favour of the existence of such a layer. In the general discussion on this problem Professor Kirchner makes the observation that diffuse bands of the type given by polished surfaces can also be obtained by reflection from suitably prepared, sputtered or evaporated films which however give sharply defined rings by transmission. But sputtered or evaporated films and the polished layer are two different things which are not directly comparable, and thus the evidence against the existence of the Beilby layer is not overwhelming. Hopkins finds that the Beilby layer is about 30 Å thick while Zees finds a layer of oriented crystals separating the Beilby layer from the polycrystalline layer underneath.

In the second part there is a very interesting paper by Professor Andrade, incorporating some remarkable results obtained by him recently. He has followed various stages in the growth of crystals in thin films of silver on heat treatment, by microscopic methods. Spherulites, *i.e.*, uniaxial crystal fibres radiating from a centre, are first formed on heating such films. These gradually grow into single crystals with their ||| planes parallel to the surface of deposition, on increasing the temperature. This observation is in agreement with the results obtained by previous workers by X-ray and electron-diffraction methods as to orientation of crystallites in metallic films on heat treatment.

The remaining papers deal with metallic coatings obtained by electro-deposition, hot dipping and spraying. Macnaughton and others present the results of a study of the hardness of electro-deposited nickel in relation to grain size, *p*H value of the electrolyte, etc. Blum and Kasper find that deposits obtained with nickel chloride solution are fine-grained and relatively smooth, strong, hard and brittle. Those obtained with sulphate baths are rough, coarse-grained, soft and ductile. Professor Kohlschütter's paper on "Somatoids" is valuable in understanding the formation of abnormal growths on the cathode during electro-deposition. Hothersall has studied the influence of the substrate on the structure of metallic coatings obtained by electro-deposition. Wood has made a thorough study of the differences between electrically-deposited metallic coatings and the normal metal by X-ray methods. He finds a broadening of the lines in the X-ray diffraction pattern of such deposits of nickel and chromium and points out a correspondence between this line broadening and the hardness of the deposit. He also finds that the brightness of the deposit was greater in the deposits showing more perfect orientation of the crystallites than in others.

The papers and the discussions which follow them provide a more or less complete survey of the subject. The discussions especially are highly stimulating and in them several interesting points are raised which may form subjects for further work. It is clear from a study of these that the method of electron-diffraction is invaluable for the examination of the structure of surface layers. But other methods involving the use of X-rays, optical properties of the surfaces and microscopic studies are also essential.

S. R.

* *Transactions of the Faraday Society*, 1935, **31**, Part 9*a*.

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